The FOUNDRY

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Castings Prepare the Food for Everyman's Table

COOKERY has existed in some form since the earliest time recorded in history, but progress toward the refinements of today has been exceedingly slow, depending largely upon the degree of civilization and the appliances obtainable. Early man utilized the sun to cook his food, but as he became more civilized and started in a small way to raise grain, fire was introduced as the source of heat. Heat first was applied to foods through the medium of heated air, but later methods were devised which permitted cooking liquids, such as water and oils. The latter methods required some type of utensil to hold the liquid and these were made first of wood and clay and later of metals. Cast iron has been used for kitchen utensils since that metal first came into use, and cast aluminum has been introduced in recent years. Today, regardless of whether it is in the greatest of American institutions, the home; in the camper's shack located on the shore of the crystal clear lake high up in the mountains, or in the most luxurious hotel in the country, when food is prepared, castings play an important part. A variety of kitchen equipment is made in the foundry, including pots, pans, skillets, Dutch ovens, griddles, grinders, egg beaters, waffle irons, ice shavers, pressure cookers, etc.

While it is different in appearance from Mother's kitchen, it is designed to produce food like Mother used to make.

Find where castings may be sold.

CONTENTS

SPECIAL FEATURES

	Page
Foundries Benefit as Leaders Attack Many Vital Problems	458
American Industry Combines To Span the Atlantic	470
Perform Fatigue Tests—By H. F. Moore and S. W. Lyon	472
Not What Price, But What Quality Iron?—By Dr. Richard Moldenke	477
States Scrap Is Not Detrimental—By David McLain	479
Builds Continuous Shop—By Henry M. Lane	481
Bill Explains How To Prevent Corrosion—By Pat Dwyer	488
Improve Quality of Gray Iron By Heat Treating—By O. W. Potter	491
Gating Governs Quality—By R. R. Clarke	496

REGULAR DEPARTMENTS

How and Why in Brass Founding — By Charles Vickers	486	**Comings and Goings of Foundrymen**	502
Family Photograph Album	498	**Foundry Association Directory**	503
What Others Are Thinking	499		
The Shakeout	500	**What the Foundries Are Doing**	506
Trade Trends in Tabloid	501		

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S. T. Johnston, Vice President, Stuart Wells Utley, President, and Executive Secretary C. E. Hoyt, Contributed Tireless Effort to the Success of the Convention

Foundries Benefit by Many Vital

UNUSUAL interest in the discussion and solution of problems facing the foundry industry featured the thirty-first annual convention of the American Foundrymen's association held at the Edgewater Beach hotel, Chicago, June 6 to 10. The entire week of meetings was a success both from the standpoint of the total registration and the attendance at the technical sessions. While the total registration was slightly in excess of 1200, the ladies present and the visitors who failed to register probably raised the total attendance to approximately 1800. Several of the technical sessions were attended by 300 foundrymen which probably is a record in the history of the association.

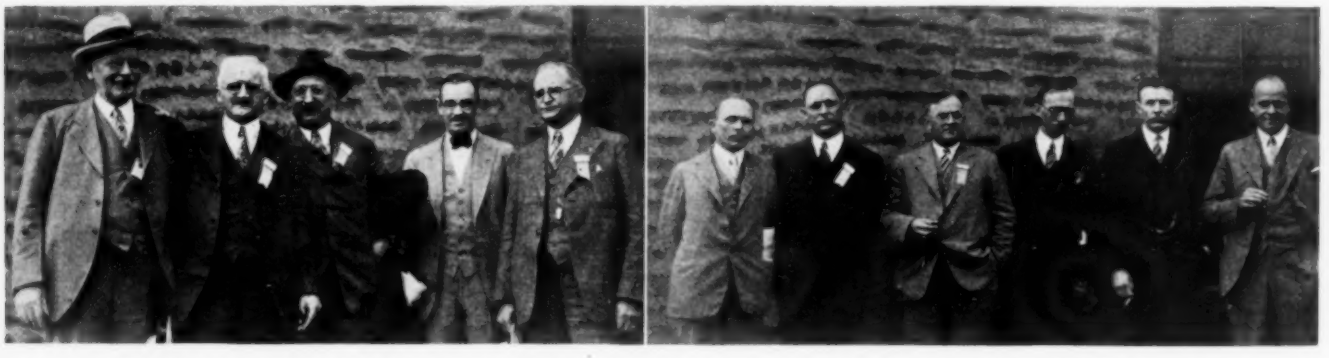
Centralization of practically all activities at the Edgewater Beach hotel, ideally fitted for such a convention, promoted acquaintanceship among those present. The breakfast gatherings, held for the first time, were exceptionally successful and permitted foundrymen to meet and discuss problems informally. The idea of devoting the first day of the convention to committee and group gatherings and holding the first technical session on Tuesday avoided many conflicts encountered in the past.

Convention visitors were entertained royally by the Chicago foundrymen. Ladies were taken on several rides over the system of wide boulevards interconnecting the beautiful parks maintained by the city and were shown many points of interest in the city. The dinner party at the Rainbo Gardens on Tuesday night was the outstanding feature of the week's entertainment. Since the large lake boats had not been placed in operation, due to the backwardness of the weather, the boat trip was abandoned and an entertainment was staged on the lake shore lawn in front of the Edgewater Beach hotel on Thursday afternoon.

Major R. A. Bull, Recipient of the Joseph S. Seaman Medal Was Prominent in all Steel Sessions

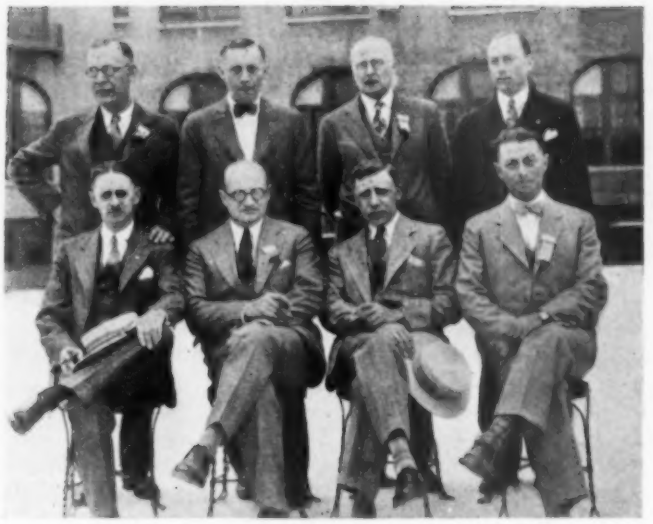
Many of the visiting foundrymen availed themselves of the opportunity to visit various foundries in Chicago and vicinity. Organized inspection trips were conducted on Monday and Friday, June 6 and 10, by the local committee composed of members of the Chicago Foundrymens' club. On Friday a large delegation visited the sand and clay industries in the Joliet, Ottawa and Utica districts of the Illinois river valley. The following companies with Mr. Volney Foster as chairman, entertained the 100 guests: Aetna Silica Sand Co., Bellrose Sand Co., Buffalo Rock Silica Co., Chicago Retort & Firebrick Co., Federal Silica Mines Co., Higby-Reynolds Silica Co., Illinois Clay Products Co., Ottawa Silica Co., Ottawa Silica Moulding Sand Co., Standard Silica Co., United States Silica Co.

Special cars on the Chicago Rock Island railroad left the La Salle street station at 10 o'clock, arriving at Ottawa and Joliet at 11:30. About half of the party decided to make the Goose Lake trip to see the plant of the Illinois Clay Products Co. where refreshments were served. A complete inspection was made under the guidance of O. L. Jones, president. The other section of the party journeyed to the Ottawa Country club where luncheon was served, and in the afternoon both parties inspected other plants which are located in this district.



(Left to Right) Eugene Smith, Robert Crawford, Ed. Frohman. J. L. Cummings and David McLain. The General Motors Corp. Was Well Represented by (Left to Right) J. E. Linabury, Arnold Lenz, Harry Tunis, F. Valtier A. L. Boegehold and H. B. Swan

fis Leaders Attack
to Problems



Quad City Foundrymen Were Represented by a Large Delegation, Including: F. W. Kirby, A. C. Howard, A. E. Hageboeck, Hyman Boernstein, John Diedrick, John Ploehn, P. T. Bancroft and W. Siefert

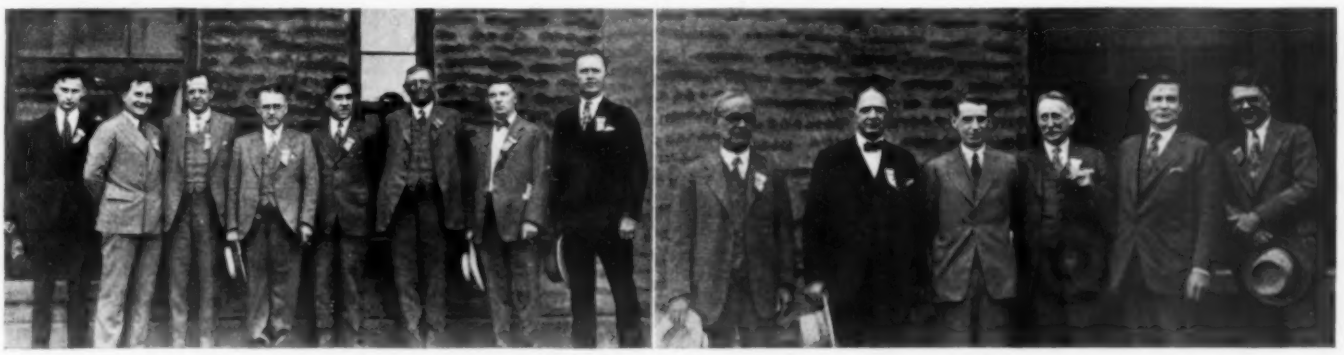
About 500 members and guests attended the annual banquet which was held in the ballroom of the Edgewater Beach hotel on Wednesday evening. Stuart Wells Utley as toastmaster read a telegram from Paul Ropsey, on behalf of the European foundrymens' associations, expressing their feeling of goodwill and wishing prosperity to the American Foundrymen's association. He then called upon S. C. Vessy, chairman of the mileage contest committee, for the results of the contest. Mr. Vessy stated that the New England Foundrymen's association with an attendance of 12 won the award, a silver mounted gavel, with a total of 12,228 miles. Mr. Utley then spoke on the history of the foundry industry and said that its beginning was estimated to be about 7000 years ago. He stated that the present age was called the materialistic age, and that he believed that more lasting progress now was being made than ever because all mankind benefited rather than the individual. In this connection he drew the picture of the influence of the foundry industry and presaged in coming years, a far greater improvement in methods and application.

Robert E. Kennedy, Technical Secretary, Provided an Excellent Program of Papers. B. D. Fuller, Chairman of the Sand Committee, Was an Active Participant

Past President A. B. Root Jr., of the association, and chairman of the board of awards then presented the Joseph S. Seaman gold medal to Major R. A. Bull, Electric Steel Founders Research group, Chicago, in recognition of his contributions to the association and to the foundry industry. The principal address of the evening was delivered by Dr. Preston Bradley, pastor, Peoples church, Chicago, who took for his subject, "Facing the Future."

The thirty-first annual convention of the American Foundrymen's association was opened formally by Pres. Stuart Wells Utley at 10 o'clock Tuesday morning with an exceptionally large number of foundrymen present. W. J. Kelly, chairman of the convention bureau of the Chicago association of commerce welcomed the American Foundrymen's association to Chicago on behalf of the Chicago association of commerce.

President Utley, in his annual report, traced the growth of the association since its organization in 1896, both from the standpoint of membership and committee activities. He then asked the chairmen of the various committees to present short reports on the work accomplished by their organizations during the year. The following committee chairmen presented reports: Dan M. Avey THE FOUNDRY, Cleveland, chairman of



(Left to Right) H. F. Bradway, H. P. Kreulen, Walter Seelbach, Charles F. Carson, A. J. Tuscany, Charles Keuthan, M. L. Spackman and J. Ovatrny, of the Ohio State Foundrymen's Association Group. The Section at the Right Indicates that Supply and Equipment Men Were Well Pleased With the Proceedings. (Left to Right) G. F. Royer, S. C. Vessy, H. S. Simpson, G. H. Wadsworth, V. E. Minich, H. H. Haley

the joint committee on pattern standardization; Maj. R. A. Bull, Electric Steel Founders Research group, Chicago, chairman of the committee on phosphorus in steel; H. Y. Carson, American Cast Iron Pipe Co., Birmingham, chairman of the committee on corrosion; H. Cole Estep, Penton Publishing Co., Cleveland, chairman of the committee on international relations; H. A. Frommelt, St. Louis, chairman of committee on training apprentices; B. D. Fuller, Whitehead Bros. Co., Cleveland, chairman of committee on molding sand research; A. E. Hageboeck, Frank Foundries Corp., Moline, Ill., chairman of committee on foundry costs; Jesse L. Jones, Westinghouse Electric Mfg. Co., East Pittsburgh, Pa., chairman of committee on gray iron castings; A. W. Lorenz, Bucyrus Co., South Milwaukee, Wis., chairman of committee on heat treatment of castings; C. N. Ring, Electric Steel Founders' Research group, Chicago, chairman of committee on foundry refractories; A. B. Root Jr., Hunt-Spiller Mfg. Corp., Boston, chairman of committee on weights of castings on blueprints.

In closing his report, Mr. Utley praised Executive Secretary Hoyt and Technical Secretary Kennedy for their splendid work during the year. He then announced the appointment of several committees as follows: Resolutions, Alfred E. Howell, Somerville Stove Works, Somerville, N. J.; chairman; Dan M. Avey, G. H. Clamer, Ajax Metal Co., Philadelphia. Judges of contest for molding apprentices, B. D. Fuller, chairman; Eugene Smith, Crane Co., Chicago; Pat Dwyer, THE FOUNDRY, Cleveland. Judges of contest for pattern making apprentices, W. F. Grill, Western Foundry Co., Chicago, chairman; Walter C. Ewalt, Walworth Co., Kewanee, Ill., C. H. Palmer, Dodge Co., Detroit. Judges for attendance contest, S. C. Vessy, W. W. Sly Mfg., Co., Cleveland, chairman; G. A. T. Long, Pickands, Brown & Co., Chicago; Miss J. Reininga. American Foundrymen's association, Chicago.

Executive Secretary Hoyt reported on the officers nominated at the recent meeting of the nominating committee in Buffalo. Since no further nominations were made, the men nominated were declared elected as provided in the constitution. Officers declared elected are as follows: S. Wells Utley, Detroit Steel Castings Co., Detroit, president; S. T. Johnston, S. Obermayer Co., Chicago, vice president; H. Y. Carson, E. H. Ballard, C. A. Goldsmith, A. E. Hageboeck, Wm. J. Nugent, directors.

Selection of Philadelphia as the meeting place for the 1928 convention and exhibition was announced in a report of the committee on exhibitions. The convention will be held May 12 to 18 in the commercial museum. The meeting was then adjourned until four o'clock Wednesday afternoon.

At the business meeting which was continued to Wednesday afternoon, June 8, the resolution adopted at the pig iron conference, authorizing cooperative work with the United States department of commerce in studying iron qualities for casting purposes, was accepted unanimously and rereferred to the board of directors of A. F. A. for approval.

Reports of several committees also were read and accepted. Benjamin F. Fuller, Whitehead Bros., Cleveland, offered the report of the apprenticeship molding contest committee, reading the names of the winners. C. E. Hoyt, executive secretary, read the report of Chairman W. F. Grill, Western Foundry Co., Chicago, of the pattern apprenticeship committee and winners of the contest held under its jurisdiction. Both reports were submitted to the board of directors for awarding of prizes.

Appreciation of those who contributed to the success of the convention was expressed in the report of the resolutions committee, presented by Chairman Alfred E. Howell, Somerville Stove Works, Somerville, N. J.

Consider General Problems

APPROXIMATELY 300 men attended the session on general foundry practice Tuesday morning, which was presided over by J. W. Bolton, the Lunkenheimer Co., Cincinnati. V. A. Crosby, the Studebaker Corp., South Bend, Ind., presented a paper on core oil specifications in which he outlines a set of specifications which govern the purchase of core oils by the Studebaker Corp. The specifications include the following chemical and physical properties: Specific gravity, flash point, fire point, iodine number, saponification number, acid number, color, odor and gallonage. H. L. Campbell, University of Michigan, Ann Arbor, Mich., took exception to the proposal of Mr. Crosby to govern core oil purchases by the chemical and physical properties. He mentioned a series of tests which were made on the chemical and physical properties at the university and stated the results of these tests failed to show any connection with the strength of the core. He recommended using bond strength as the measure of core oil quality. In reply Mr. Crosby stated that a set of specifications such as he is using assures the purchase of oils capable of meeting conditions previously determined. Such a set of specifications, governing the chemical and physical properties prevents the manufacturer of core oils from using cheaper materials which will not produce the desired results. Werner G. Smith, Werner G. Smith Co., Cleveland, stated that the specifications governing physical and chemical properties, such as are used by Mr. Crosby, aid materially in the technical research that now is being carried on by the staffs of leading manufacturers of core oils. However, he pointed out, that no specifications can be drawn up which will cover the entire field. Specifications such as presented by

W. J. Nugent, Chairman of the Chicago Committee, Found Time Among His Many Activities for a Chat with F. M. Robbins of Chattanooga, Tenn.

Mr. Crosby, while highly satisfactory for use in various foundries specializing in automobile castings, would not be suitable for the radiator shop or the jobbing foundry. He stated that every foundryman will find it necessary to make specifications to meet his particular needs. He agreed with Mr. Campbell that bonded strength may be used as a test, but the many variables which are encountered in making cores makes the test not entirely practicable. R. B. Schaal, Roberts & Mander Stove Co., Hatboro, Pa., stated that he considered the chemical and physical tests the best guide in buying oils.

Test Bars to Establish the Fluidity Qualities of Cast Iron, the exchange paper of the Association Technique de France written by C. Curry, Ardennes, France, was read by James T. MacKenzie, American Cast Iron Pipe Co., Birmingham, since Mr. Curry was not able to be present.

The third paper covered the subject of foundry blackings and was written by D. G. Anderson and A. N. Ogden, the Western Electric Co., Chicago. The authors presented a method of determining the usefulness of foundry blackings by electrical resistance. A special pneumatic agitator for mixing blacking also was described. R. F. Harrington, Hunt-Spiller Mfg. Corp., Boston, pointed out that many of the defects in castings credited to the molder are due to blacking improperly prepared. Factors requiring consideration in using coke blacking also were discussed by several foundrymen.

The last paper at the session, the Analysis of Four Hundred Tons of Defective Castings by J. M. Haley, Crompton & Knowles Loom Works, Worcester, Mass., was read in abstract by R. E. Kennedy. Defects, indicated by a study of the castings, were classified and methods were presented to eliminate these defects in the future. Eugene Smith, the Crane Co., Chicago stated that about 90 per cent of defects are caused by poor equipment and supplies provided to the molder.

A. E. McClintock, L. W. Olson and Dean C. B. Connelley Enjoyed the Outdoor Vaudeville Performance Held at the Hotel Thursday Afternoon

Discuss Quality of Pig Iron

A QUESTION which has been tossed about between foundrymen and pig iron makers for years was brought out for full and free discussion at the conference on the qualities of pig iron for casting purposes held Tuesday afternoon. Briefly stated the question is whether pig iron is as good as it used to be and if not, why not. R. H. Sweetser, American Rolling Mill Co., Columbus, O., who presided at a previous conference on the same general subject before the American Institute of Mining and Metallurgical Engineers during the past winter, and who acted as chairman of the A. F. A. session, stated that blast furnaces now are using about ¾-pound of coke per pound of iron as contrasted with 2 to 3 pounds of coke some years ago, and undoubtedly scrap is being remelted in the blast furnace to improve melting conditions.

Dr. Richard Moldenke, Watchung, N. J., who presented the opening statement for the foundrymen's side of the argument, gave a history of the agitation for some standard method of evaluating pig iron quality. In his brief paper he asks for something more definite than the chemical analysis now followed, since these do not show wherein certain irons produce inferior castings. He points to the decline in iron quality during the past few years and ascribes this condition to the increased use of scrap. His paper appears in this issue.

C. C. Kawin, Chicago, discussing Dr. Moldenke's paper, questioned whether the pig iron today is in any way inferior to that obtainable a few years ago. R. F. Harrington, Hunt-Spiller Corp., Boston, affirmed that various characteristics are found in different lots of iron that are not traceable to chemical content alone. He stated that lack of uniformity is evidenced by much greater shrinkage in some grades not found in others that are similar.

R. S. MacPherran, Allis-Chalmers Mfg. Co., Milwaukee, chairman of the joint committee on cast iron, stated that while no evidence exists that the addition of scrap and particularly borings in the blast furnace produces poor castings, questioned why furnacemen are evasive and mysterious

Seek Investigation

A RESOLUTION, offered by R. S. MacPherran, chairman of the joint committee on cast iron, was adopted unanimously at the conference on the qualities of pig iron for casting purposes. The resolution is as follows:

Be it resolved, that it is the consensus of this assembly that a co-operative study of the effects of varying blast furnace operations on the character of pig iron made under changing blast furnace conditions, and on the castings made therefrom, be conducted under the supervision of the department of commerce, with an advisory committee consisting of representatives of the national technical associations, such as the American Foundrymen's association, American Pig Iron association, American Institute of Mining and Metallurgical Engineers, and the American Society for Testing Materials.

as to whether these materials are added to the burden. He said if scrap additions are good, why the secrecy; if bad, stop making them.

D. L. Ward, Byproducts Coke Corp., Chicago, speaking for the furnace interests denied any retrogration in pig iron quality. He stated that hard driving in furnace operation does not injure pig iron quality. As showing that less chance exists for oxidized iron today than in years past, he showed that merchant furnaces are working with 83 per cent increased production, but with 15 per cent decrease in the cubic feet of air per square foot of hearth area and a total decrease of 44 per cent in the volume of air per unit of iron tapped, comparing practice today with that in 1910.

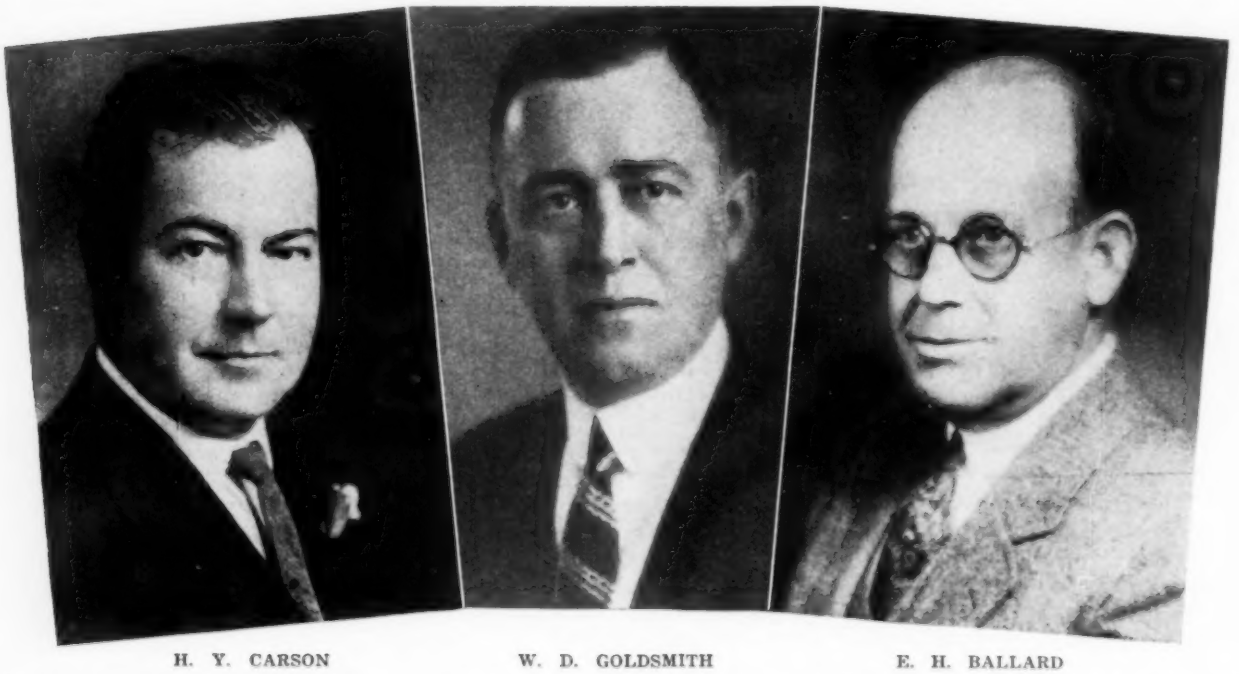
James A. Murphy, Hamilton, O., said that only one word described foundry iron in the past 8 years, in his opinion, and that word was *wrong*. He said that pig iron sellers implied that price competition forced them to disregard quality, but pointed out that during the period mentioned the furnaces had sold iron at makers' rather than foundrymen's prices. He said that the increased use of scrap is only one of the ways followed in getting rid of old flivers.

Steel in The Charge

David McLain, McLain's System, Inc., Milwaukee, said that in his opinion further analysis giving data on metalloids other than carbon, silicon, phosphorus, manganese and sulphur is needed. He has found the use of steel scrap beneficial in the cupola and believes its use in the blast furnace is satisfactory. Further, he holds that iron scrap in the furnace is not harmful. His paper appears in this issue of THE FOUNDRY.

Representatives of various furnace interests insisted that pig iron today is as good, if not better than that made years ago. They pointed to the present day ability to make appropriate coal mixtures, to regulate oven temperatures and other factors tending to produce a uniform quality of coke impossible of attainment in the past. George A. T. Long, Pickands, Brown & Co., Chicago, stated that pig iron is better today, but that foundry melting conditions lack uniformity particularly as regards volume and pressure of air delivered through cupola tuyeres. H. B. Swan, Cadillac Motor Car Co., Detroit, questioned whether anyone could define what constitutes good pig iron. He doubts if pig iron obtainable 25 years ago would make as satisfactory cylinders as that used today. Walter Wood, R. D. Wood & Co., Philadelphia, stated that something akin to

Association Elects Three New Directors



H. Y. CARSON

W. D. GOLDSMITH

E. H. BALLARD

H Y. CARSON, whose election as director of the American Foundrymen's association was announced at the recent convention, was born at Danville, Ill., April 1, 1887 and was graduated from the University of Illinois, Urbana, Ill., in 1911. During 1911 and 1912 he was branch manager and chief engineer, Carson-Payson Co., Danville, Ill. and Indianapolis. From December 1912 to June 1914 he was assistant professor and superintendent of construction in the office of the supervising architect, University of Illinois. During the summer of 1914 Mr. Carson took post graduate work at Harvard university, Cambridge, Mass., in the school for health officers. From September 1914 to February 1918 he served as sanitary engineer for the Central Foundry Co., New York,, being in charge of the department. Mr. Carson was sanitary engineer, American Red Cross commission to Palestine with British forces from Egypt at Jerusalem from February 1918 to March 1919. He was in charge of the engineering equipment of the unit. Since April 1919 he has been research engineer, American Cast Iron Pipe Co., Birmingham. Mr. Carson has been actively identified with corrosion research and cast iron research, being the A. F. A. representative on the National Research council committee on corrosion and a member of A. F. A. and A. S. T. M. committee on cast iron and corrosion.

W D. GOLDSMITH, also announced as a director of the A. F. A., is treasurer and general manager, the C. A. Goldsmith Co., Newark, N. J. Mr. Goldsmith received his education at both Princeton and Lehigh universities. He has been active in the work of a number of associations, having been vice president for several years of the Newark Foundrymen's association and also vice president of the Metropolitan Brass Founders' association, New York. He is vice president of the Port Newark National bank, a member of the Essex club of Newark, the Newark Athletic club and the Rotary club.

E H. BALLARD, who will serve as director of the A. F. A. for three years, was born in Hartford, Conn., March 3, 1883. His father, who was connected with the Thomson-Houston Electric Co., moved to Lynn, Mass. when the plant changed its location, in 1883. From the time he was 13, Mr. Ballard worked in various departments of the plant during the summer months. In 1894 he accepted a position as clerk in the steel foundry department which was started at that time. Through the kindness of W. P. Darling, manager of the steel foundry, he was able to obtain special training in laboratory and general foundry practice in connection with his regular duties. In 1905 Mr. Ballard resigned to accept a position as superintendent of the Massachusetts Steel Casting Co., Everett, Mass., which later was absorbed by the General Electric Co. At present he is general foundry and pattern shop superintendent of the Lynn and Everett, Mass. plants of the General Electric Co. Mr. Ballard has been actively associated with association work being a past president of the New England Foundrymen's association. He has served on committees of the A. F. A. and now is a member of the joint committee on pattern equipment standardization.

personality would be found in iron that could not be determined by analysis.

Dr. C. H. Herty, bureau of mines, Pittsburgh, speaking for his organization and for the bureau of standards which also operates under the department of commerce, offered the co-operation of these government agencies in solving the moot questions between the foundry and furnace interests. A resolution, offered by Mr. MacPherran and unanimously adopted by vote of some 200 interested individuals present, provided for a joint advisory board to work with government agencies in this undertaking. This board will consist of representatives of the American Foundrymen's association, the American Pig Iron association, the American Institute of Mining and Metallurgical Engineers and the American Society for Testing Materials.

Foundry Needs More Apprentices

OPENING the apprenticeship training meeting over which C. J. Freund, Milwaukee, presided H. A. Frommelt directed attention to the fact that a recent survey conducted by the Engineering Foundation indicates that at least 1,000,000 apprentices actually are needed at present to meet the needs of the basic industries of the United States.

Out of this seemingly large number approximately 10 per cent or 100,000 are needed in the foundry industry alone instead of approximately 1000, the number of apprentices actually learning the molding trade. Owing to several conditions, some local and some national in character, the shortage, except in isolated instances has not made itself felt acutely. However, the situation, slowly but surely is becoming serious and he urged immediate action. Quite appropriately he claimed that the American Foundrymen's association should sponsor the movement and individually and collectively, the members should give the movement active support.

F. A. Lorenz, works manager, American Steel Foundries, East Chicago, Ind., commented on the change which gradually has taken place in the foundry industry and which has converted it from a somewhat indiscriminate business, with no fixed standards or methods into a highly specialized industry in which mechanical equipment, scientific methods and metallurgy play a more important part than individual skill.

He doubted the efficacy of the method adopted during the war years when nearly all attention was devoted toward training men for foremanship. Many of these men might qualify as excellent mechanics but they had no qualification as teachers. A suggested remedy is to provide technically trained young men as teachers and a selected list of boys, preferably not over 16 as apprentices. He deplored the prevailing attitude of American parents toward the prospect of their boys becoming ordinary workmen and claimed an organized movement should be launched to sell the idea of industry as just as honorable and worth while as any other walk of life.

Papers presented and discussed during the meeting included: Apprenticeship as a Labor Stabilizer, by A. W. Gregg, Bucyrus Co., Milwaukee; Making Apprenticeship Pay Dividends, by W. P. Perry, Bay City, Mich.; A Publicity Program Justified by Correct Methods of Apprenticeship To Attract Young Men, by H. R. Roesch, Chicago; Careful Selection and Supervision Are Important in Reducing Apprentice Turnover, by W. Watson, Milwaukee; Metal Trades Association Launches a New Campaign in Milwaukee, by C. J. Freund, Falk Corp., Milwaukee; Apprentice Training Situation in the Pittsburgh District, by C. B. Connelley, Carnegie Institute of Technology, Pittsburgh; Co-operation First Essential Toward Success in Apprenticeship, by H. Jansen, Moline.

Instructors Meet

DEFINITE steps toward the formation of a permanent organization were taken by a representative group of men engaged in teaching foundry practice at the various engineering schools, at a meeting held in the Edgewater Beach hotel, Chicago, on the first day of the convention. The meeting was held under the chairmanship of B. W. Benedict, University of Illinois, Urbana, Ill., and included men from the University of Illinois; Carnegie Institute of Technology, Pittsburgh; University of Nebraska, Lincoln, Neb.; Case School of Applied Science, Cleveland; University of Michigan, Ann Arbor, Mich; University of Washington, Seattle Wash.; Cornell University, Ithaca, N. Y.; and Armour Institute, Lane and Harrison Technical schools, Chicago.

The meeting was the third of the kind held in recent years and the discussion principally was confined to the report of three committees appointed to consider respectively: A study of the instruction courses, laboratory equipment and co-operation between the schools and industrial establishments. A motion was adopted to enlist the aid of the American Foundrymen's association in collecting and tabulating data on the present equipment of the various schools and publishing this material with additions from time to time, so that uniformity may be established and the various schools be in a position to keep step with the industry.

It was pointed out that the young men taking these courses are beyond the manual training stage and that the instruction should follow theoretical rather than plainly utilitarian lines. They are destined for positions

Announce Winners

PATTERNS submitted in the pattern making apprentice contests were judged by W. F. Grill, Walter C. Ewalt and C. H. Palmer and prizes awarded as follows:

1. Siegfried V. Hanson, Pettibone-Mulliken Co., Chicago.

2. Joseph L. Asp, Pettibone-Mulliken Co., Chicago.

3. Lester G. Furber, Brown & Sharp Mfg Co., Providence, R. I.

Four steel and 18 gray iron castings were entered in the apprenticeship molding contest. The judges, B. D. Fuller, Eugene W. Smith and Pat Dwyer awarded the prizes for gray iron castings as follows:

1. H. E. Stromberg, General Electric Co., Lynn, Mass.

2. Y. Sawtelle, General Electric Co., Lynn, Mass.

3. W. Urquhart, General Electric, Lynn, Mass.

Winners in the steel casting contests are as follows:

1. Carl H. Oleson, Pettibone-Mulliken Co., Chicago.

2. Andrew Bottom, Falk Corp., Milwaukee.

3. Joseph Buenet, Falk Corp., Milwaukee.

William McLeary, Consolidated Mining & Smelting Co., Trail, B. C., won the individual prize for traveling the greatest distance to the convention.

The New England Foundrymen's association won the mileage contest with 12 members traveling a total of 12,228 miles.

of leadership and require instruction to qualify them for a wider field than that of mere mechanics. Cognizance was taken of the fact that the time set apart for foundry instruction unavoidably is too short and an effort should be made to compress the essentials more closely, that the entire ground may be covered satisfactorily.

Reviews Metallurgical Progress

AN UNUSUALLY keen interest was exhibited in the session on cast iron metallurgy which took place Wednesday afternoon with an attendance of 200 under Chairman R. F. Harrington, Hunt-Spiller Mfg. Co., Boston. Four papers were presented on the various phases of metallurgy and these dealt with graphite formations, fatigue tests, growth of cast iron and the effect of alloy additions.

The first paper to be presented was that on the Growth of Cast Iron, by Dr. J. H. Andrews, Glasgow, Scotland. In the absence of Dr. Andrews excerpts from the paper were read by H. L. Bornstein, Deere & Co., Moline, Ill. This paper gave an excellent summary of the various investigations that have been carried on during the past few years. From these works and his own, the author concludes that the underlying causes for growth are graphitization of combined carbon, percolation of air through graphite flakes, oxidation of ferrite, and previous treatment. J. T. MacKenzie, American Cast Iron Pipe Co., Birmingham, Ala., E. J. Lowry, Hickman-Williams Co., New York, R. B. Schall, Roberts & Mander Stove Co., Hatboro, Pa., discussed the paper and remarked that the silicon content has a greater effect than the total carbon content, lower silicon iron having less growth.

Fatigue Tests of Cast Iron, by H. F. Moore and S. W. Lyon, University of Illinois, Urbana, Ill., was the second paper presented, and brought out some interesting data on this phase of cast iron metallurgy. This paper appears on subsequent pages of this issue of THE FOUNDRY.

J. W. Bolton presented his paper on graphite formations in gray cast iron. Mr. Bolton's paper is a continuation of the investigations he has made during the past seven years. He brought out one conception of microscopic investigation that generally has been overlooked. This is the three-dimension form of graphite particles. This factor accounts for the various appearances of graphite under the microscope, that is a long flake, a round particle or a point, and is due to the section through which the particle is cut.

Considerable discussion arose on various points which Mr. Bolton explained, such as analysis of specimens, etc. R. B. Schall, Roberts & Mander Stove Co., Hatboro, Pa., stated that for stove plate work, he found that iron with a ferritic structure gave better results and it was pointed out by E. J. Lowry, J. T. MacKenzie and J. W. Bolton that pearlitic structure obtained in the case of high total carbon content was not the same as that obtained from lower total carbon irons, consequently the strength of the cast iron in the former case would be considerably lower than in the latter.

The effect of alloy additions to cast iron was presented in the paper by R. S. Poister, Electro Metallurgical Sales Corp., New York. The author gave results obtained by himself and others on the effect of nickel and chromium additions to cast iron and the general opinion was that a beneficial effect resulted, provided the melting methods were good, otherwise the effect is likely to be indifferent.

H. S. Austin, Campbell, Wyant & Cannon Foundry Co., Muskegon, Mich.; M. J. Gregory, Lakey Foundry & Machine Co., Muskegon; D. M. Houston and Mr. Bardwell, both associated with the International Nickel Co., New York, stated that their experience coincided with that of Mr. Poister. Mr. Austin also stated that the silicon content has a greater ef-

A. E. HAGEBOECK, whose re-election to the board of directors was announced at the Chicago convention, is secretary-treasurer of the Frank Foundries Corp., Davenport, Iowa., and Moline, Ill. He was educated in the University of Chicago, Chicago, and was graduated from the University of Iowa in 1907. For five years after graduation he had charge of boat and barge construction on the Mississippi river with the United States engineering corps. From 1912 to 1915 he had charge of the Birmingham plant of the F. J. Lewis Mfg. Co. In 1915 he purchased an interest in the Frank Foundry & Machine Co., Davenport, and spent a year at that plant. In 1916 the company built a second plant at Moline. Mr. Hageboeck has taken an active part in the work of the American Foundrymen's association, being chairman of the committee on foundry costs and a member of the board of directors since the Milwaukee convention in 1924. He also helped to organize the Quad City Foundrymen's association and served as president of that organization for a year and a half.

WILLIAM J. NUGENT, re-elected to the board of directors of the American Foundrymen's association, is president and general manager of the Nugent Steel Castings Co., Chicago. Mr. Nugent has been connected with the foundry industry since 1902 when he became secretary to the president of the American Steel Foundries, Chicago. From 1905 to 1907 he was manager of the order department of that company. To gain practical knowledge of the foundry business he served a 5-year apprenticeship course at the Indiana Harbor, Ind., plant of the American Steel Foundries, serving in succession as cleaning room foreman, production manager and superintendent. From 1912 to 1917 he was works manager of the Sivyer Steel Castings Co., Milwaukee. He held a similar position at the Springfield plant of the Ohio Steel Co. from 1917 to 1918. In 1918 he became associated with the Electric Steel Co., Chicago. The name of that company later was changed to the Nugent Steel Castings Co. Mr. Nugent has served on the board of directors of the American Foundrymen's association since 1924.

fect on the structure where an alloy is used than the total carbon content. In the discussion it also was stated that the brinell hardness does not indicate the wear resistance of cast iron.

Cost Accounting Is Live Topic

OUTLINING the points to be considered at the session on cost accounting, A. E. Hageboeck, Frank Foundries Corp., Moline, Ill., stated that the movement primarily is of an educational character. Probably the majority of foundrymen realize that some form of cost system is essential in their business, but for various reasons it has not been adopted in many cases. Approximately 50 per cent of the steel foundries are operating under a system in whole or in part similar to that observed by the Steel Founders Society of America. A similar percentage has adopted, with local variations, the method sponsored by the American Foundrymen's association. The same applies to the makers of malleable castings who follow the lead set by the Malleable Iron Research institute. He expressed regret that up to the present the founders of nonferrous castings have taken no concerted action on the subject and only in isolated instances has action been taken individually. The best way to study the cost question is by the establishment of local groups of foundrymen. At present 12 such groups are operating in this country.

J. L. Carter, Barlow Foundry, Inc., Newark, N. J., presented a report on the manner in which one of these groups is organized in his district and pointed to many general and specific instances of its success. Two cases were cited in which a yearly saving of $5000 has been effected. In a third instance, intensive study of conditions induced by a cost analysis has led to the elimination of 12 men with a consequent saving of approximately $12,000.

He explained that a uniform cost system does not imply uniform cost figures by all the members of the group. It simply means that all foundries figured their costs on a uniform basis. That is, the same factors of cost are taken into account. Individual costs of the various foundries vary according to the class of castings, personnel, equipment, location and other local features.

Steel Specifications Threaten

SPECIFICATION changes threatening certain producers of steel castings developed keen interest at the session on steel founding Wednesday afternoon at which R. A. Bull, Electric Steel Founders' Research group, presided.

The report of the A. F. A. committee on steel castings was read in abstract by Chairman A. H. Jameson, Deemer Steel Castings Co., New Castle, Del. Mr. Jameson reported that in regard to high temperature carbon steel valves, flanges and fittings, the committee A.1 of the American Society for Testing Materials voted to permit the use of the open-hearth and the electric furnace, thus excluding the converter and the crucible, and to impose chemical limits in addition to the present physical requirements. The specification changes have been approved by the subcommittees and the general committee, adopted as tentative by letter ballot and will be submitted to a vote of the A. S. T. M., at the meeting at French Lick, Ind., June 22.

Mr. Jameson briefly outlined the work that has been done by the A. F. A. members of the materials committee to prevent the action which has been taken. He stated that while the chemical limits are such that they can be met, a great principle is at stake, and the adoption of these specifications by the A. S. T. M. will be an opening wedge which may result in the limits being shortened sufficiently to work a great hardship upon steel foundrymen. He also stated that the foundry industry does not want limits placed upon the chemical or physical properties of the product which may prevent the foundry from improving its practice and producing a better casting for the customer. Frank M. Robbins, Ross-Meehan Foundries, Chattanooga, Tenn., stated that all steel foundrymen should oppose the specifications on a matter of principle. Talks by other steel foundrymen present indicated the casting producers are opposed strongly to the specifications.

A resolution was passed unanimously protesting the discrimination against certain processes and the imposing of chemical limits other than those proscribing elements that are known as deleterious.

J. M. Sampson, General Electric Co., Schenectady, N. Y., presented an abstract of a paper on a new type of mold drying oven. The paper was prepared by Mr. Sampson and G. H. Wright. The high degree of humidity in the oven during the early stages of drying, due to the introduction of steam, and the principle of keeping the air in the oven in circulation are the features of this oven. E. H. Ballard, General Electric Co., Lynn, Mass., stated that the molds baked in this oven had a better appearance than those he has seen baked by other means, and that the face of the molds are free from surface checks. When questioned by C. N. Ring, Electric Steel Founders' Research group, Mr. Sampson stated that the length of time required to dry the molds is not increased with the new type oven.

Characteristics of Some Steel Molding and Core Sand Materials, by E. R. Young, Detroit Steel Casting Co., Detroit, was the second paper on the program. The author shows the characteristics of a number of materials used in preparing steel and core sands and states that what is needed to improve the present practice is a material which will retain its bond at extremely high temperatures, or which will cause the sand mixture to glaze at the high temperature.

Prof. H. F. Moore, University of Illinois, Urbana, Ill., delivered an illustrated lecture on Fatigue Tests of Cast Steel. From a series of tests performed, he concludes that with proper care in manufacture and heat treating, steel castings can be made which should resist fatigue stresses exceedingly satisfactorily. In answering a question asked by W. J. Corbett, Steel Founders' Society of America, Pittsburgh, concerning the

comparative strength of cast steel and welded rolled stock, Mr. Moore stated that tests at McCook Field, Dayton and by several manufacturers indicates that it is not possible to secure over 60 to 70 per cent of the strength of cast steel in welded rolled stock. However, the data investigated by Mr. Moore were secured some time ago and newer welding equipment may have raised the percentage slightly due to changes in practice.

The report of the A. F. A. committee on heat treatment of ferrous metals was read by chairman A. H. Lorenz, Bucyrus Co., Milwaukee. The report outlines the work that has been done by the proper committee of the A. S. T. M. in developing a set of definitions covering annealing, heat treatment, normalizing, etc. Discussion brought out the fact that a specific name should be found for the annealing operation followed in the steel foundry to distinguish it from annealing followed in the manufacture of other products.

Study Phosphorus

Major Bull presented the report of the A. F. A. representative on the committee to investigate the effect of phosphorus and sulphur in steel. An investigation is being organized to make tests on samples of steel having various percentages of phosphorus. These samples are to be poured in a plant to be determined later and will be tested in laboratories maintained by the government. Mr. Bull stated that the committee estimates the cost of the investigation would be $1500 and that $750 has been donated by the Steel Founders' Society of America and $125 by the Electric Steel Founders' Research group. It is proposed to raise the remainder of the expense money from the steel foundries in the country which are not members of the two organizations mentioned in the committee report.

Checks Temperatures in Cupolas

INTEREST in one of the three final closing technical sessions of the convention centered in a discussion of a paper presented by H. W. Dietert, United States Radiator Corp., Detroit, and entitled Correction of Cupola Operation by Means of Cupola Temperature Recorder. Reading of the paper was amplified by the presentation of a number of slides showing application of the apparatus in the various plants operated by the company with which the author is identified.

With slight variation in the method of mounting, the apparatus may be utilized in connection either with a cupola operated intermittently or continuously. As was explained in a paper presented by the same author at the Detroit convention in 1926 the instrument does not indicate the actual temperature of the iron in the spout. The end of the thermocouple is suspended a few inches above the stream and indicates the temperature at that point.

Use for Comparison

For the purpose of making average comparison day by day this temperature is of the same value as if the actual temperature were recorded. Any variation in the temperature while the stream is running warns the operator so that he may take the proper remedial measures. However, its greatest value is that a complete record is made of the temperature throughout the heat and steps may be taken on the following day to synchronize the various factors of operation to insure uniform results. Answering a question from the floor Mr. Dietert explained that the blast is regulated by a gate in the main wind pipe.

The annual exchange paper by Jacques Varlet, Sclession, Belgium, entitled Cast Chaplets and Tinned and Untinned Core Irons, was read by R. E. Kennedy. Other papers included one by S. C. Schaller, University of Washington, Seattle, entitled A Study of Cupola Lining Refractories and a report of the joint committee on pattern equipment by Chairman D. M. Avey, THE FOUNDRY.

Sand Session Holds Interest

REPORT of four general committees, reading of two formal papers and lively discussion both on the reports and the papers at the meeting, Wednesday morning, by an audience which taxed the capacity of the meeting room, served to indicate the interest which molding sand has aroused among members of the foundrymen's association. The subject has been vitalized by talks and demonstrations at local meetings during the year.

Report of the general committee was presented by the chairman, B. D. Fuller, who also is chairman of the joint committee on sand research of the American Foundrymen's association and affiliated societies. He outlined in a general way the activities of the committee during the past year and some of the proposed lines of research to be followed in the coming year. In the absence of A. A. Grubb, Ohio Brass Co., Mansfield, O., the chairman of the sub-committee on sand control and classification methods, Mr. Fuller read the report, indicating the work the committee already has done on this subject. The report was amplified by R. E. Kennedy, technical secretary of the American Foundrymen's association, who, among other features, explained the graphic table appearing in the printed report.

Subject Broadens

In presenting the report of the subcommittee on tests, the chairman, Dr. H. Ries, Cornell University, Ithaca, N. Y., stated that the farther his committee has gone into the subject, the wider it has found the field. He has found it necessary to appoint several subcommittees to study specific minor features. While progress has been made along many lines the work necessarily has been slow and the committee is not yet prepared to submit any definite findings.

R. F. Harrington, Hunt-Spiller Corp., Boston, chairman of the subcommittee on sand conservation and reclamation, outlined briefly several methods of reclamation in practical use and stated that his committee now is experimenting with a viscosity test for clay. He emphasized the fact that the greatest care and closest supervision are essential factors in any reclamation project.

One of the papers presented at the (*Concluded on Page* 468)

VISITORS and their ladies were deeply appreciative of the various entertainment features offered by their Chicago hosts. The sightseeing tours, the special cabaret dinner at the Rainbo Gardens and the lawn party and dance Thursday were well attended.

(*Concluded from Page* 466)
meeting, Routine Sand Control Methods in the Pipe Foundry, was prepared by M. Kuniansky, Lynchburg, Va. The other, Effects of Moisture Absorption on the Properties of Dry Sand Cores, was presented by Prof. H. L. Campbell, University of Michigan, Ann Arbor, Mich. who has been studying core sands and binders.

Rebonds Used Sand

APPLICATION of clay as a bonding agent for old sand in malleable foundry practice engaged the attention of a gathering of malleable foundrymen Wednesday afternoon under the chairmanship of L. C. Wilson, Federal Malleable Co., Milwaukee, assisted by H. B. Hanley, Whitehead Bros. Co., Rochester N. Y. and H. W. Dietert United States Radiator Corp., Detroit, who took part in the discussion which followed.

Discussion revolved principally on points brought out in a paper on synthetic molding sands in the Malleable foundry presented by F. C. Scheiber, General Electric Co., Erie Pa. This paper refers briefly to past and present conditions in the foundry under the charge of the author, which led to the adoption of synthetic sand. Early experiments, present method of preparation and some of the savings effected and other advantages of the change are described. Complete data on results obtained by its use also are presented.

The author said, in the foundry with which he is connected, from 20 to 25 tons of sand are treated daily, about 350 tons of sand are in use on the floor and the saving effected by the present method of rejuvenating the sand amounts to approximately $1000 per month. One of the important items credited to the use of synthetic sand is the reduction of scrap from 18 per cent to 7 per cent and a scrap loss in the machine shop from 5 per cent to less than 1 per cent. Some of this reduction may be due to the fact that a tightening up all along the line of inspection and supervision naturally follows the introduction of new methods and new materials in the foundry.

Discuss Malleable Shop Practice

UNDER the chairmanship of L. C. Wilson, Federal Malleable Co., Milwaukee, the session relating to malleable foundry problems was held Thursday morning, with about 75 members and guests present. The first paper presented was that by Prof. R. S. McCaffery, University of Wisconsin, on the cause of variations in pig iron. Prof. McCaffery attributed the variations to the changes in the amounts of the compounds present, such as iron silicide, manganese sulphide, etc. The temperature is the governing factor in determining the amounts of these various compounds in the resulting metal.

Tentative specifications for the sizes of refractory brick blocks, etc., for malleable foundries were presented by James R. Allan, International Harvester Co., Chicago, and he stated that these had been adopted for the present. Some minor changes had been made since the Detroit convention, but in the main the specifications are the same as suggested at that time.

Fred L. Wolf, Ohio Brass Co., Mansfield, O., presented some data on pickling solutions for malleable and said that a bath containing 5 to 6 per cent sulphuric acid worked excellently. The pickling operation required about 35 minutes. Ventilation for removal of fumes was found to increase the amount of work the picklers could perform. He said pickling costs about $1.60 per 1000 pounds, but that for his company's work sandblasting is a little cheaper and that it is turning to that method. He also stated in case of a hard iron silicate skin, that 2 per cent hydrofluoric acid added to the regular bath removes this skin, due to the action of the acid upon the silica compound.

Reduce Brass Foundry Losses

OUTLINE of a system adopted by the Ohio Brass Co., Mansfield, O., by which molding losses are reduced through a *baseball plan* of organization in that company's plant was given at the Thursday morning nonferrous founding session by R. A. Greene, assistant superintendent of the Ohio Brass Co. The plan essentially provides for a scheme of friendly rivalry among the molders themselves and functions for results.

Mr. Greene pointed out that the company's molders are paid for the number of molds they make, with pay deductions enforced in case of dirty and shifted castings. Instructors have charge of groups of about 15 molders each. Accurate records are kept of each molder's work and losses, his percentage of loss is posted daily on a bulletin board, the individual losses of more than 5 per cent being posted in red ink. The group instructors' percentages of progress are plotted on charts. Losses, said the speaker, have been cut from a yearly average of about 8½ per cent to a yearly average of about 4½ per cent, which in this plant means a saving of about 200,000 pounds of castings.

C. J. Zaiser, of the American Metal Products Co., Milwaukee, presented the paper on the improvement of aluminum bronze, originally prepared by Dr. R. C. Reader, Birmingham, England, for the Aluminum Bronze Manufacturers institute. Useful properties of the 10 per cent aluminum bronze can be further improved by addition of one or more extra elements; the use of chill castings instead of sand castings; correct casting temperature, and in case of die casting, a correct mold temperature; correct mold design; and correct position of the casting in the mold; correct position of the feeder head; and the employment of heat treatment, it was brought out by the paper and discussion. The discussion also brought out that the addition of nickel by a minimum of 3 per cent adds density to the casting and inhibits grain growth of the structure.

Problems in the gating of nonferrous castings were taken up and discussed from drawings submitted by R. L. Binney, Toledo, O., D. E. Brog-

gi, Neptune Motor Co., Long Island, N. Y.; C. V. Nass, Ohio Brass Co., Mansfield, O.; W. F. Herst, general superintendent, Wolverine Brass Works, Grand Rapids, Mich.; E. F. Hess, Ohio Injector Co., Mansfield, O., and other brass foundry executives.

Nonferrous Melting Units Are Studied

Difficulties met in commercial brass foundry practice and practical methods of solving them were discussed at the roundtable conference held Wednesday afternoon, June 8, under the chairmanship of N. K. B. Patch, Lumen Bearing Co., Buffalo. One question involved the comparison of melting losses on yellow brass in electric and in crucible furnaces. While the consensus of opinion was that operating efficiency largely governs success with either equipment, losses as low as 1½ per cent were cited for electric furnaces One speaker described a 30-day test on 60-40 yellow brass, all scrap charges and billet pouring, which gave a net loss of 0.68 per cent.

A comparison of quality of castings obtained from electric and from crucible furnaces developed the conclusion that uniformity is the deciding factor and depends largely on operation, and whether borings, clippings or scrap metal is used. Control of the type of atmosphere used and of all operating conditions, it was brought out, also are important. In this connection, the reliability of open-end versus closed-end pyrometers was considered, with arguments on both sides presented. It was declared that the open-end type must be checked frequently for accuracy, but that it gives quicker readings. In final analysis, it was felt, skillful use of pyrometric equipment brings savings by pointing out weakness in use.

In discussing the gasification of nonferrous castings, it was stated that this condition is due largely to pouring at temperatures too high. Pouring out of newly-lined ladles, when slightly damp, one speaker said, always results in a gaseous condition. If the metal is poured properly and at a lower temperature, in all probability this gaseous condition will not appear.

Visit Blast Furnaces

Tennessee Products Corp. was host to 46 members of the iron and steel industry at Nashville, Tenn., June 9 and 10, during a trip to the Wrigley and J. J. Gray Jr., blast furnace plants. Special cars left Pittsburgh and Chicago where some members of the party were attending the annual convention of the American Foundrymen's association. The party was met by Rogers Caldwell, J. J. Gray Jr., and others upon its arrival at Nashville and entertained at breakfast.

The party then was taken by bus to Rockdale, Tenn., stopping at Columbia for luncheon. The plant at Rockdale, formerly owned by J. J. Gray Jr., produces ferrophosphorus. After witnessing various operations, the visitors watched the furnace make a cast of ferrophosphorus. The party then returned to Nashville where it was a guest of Frederick Leake, secretary and director of sales, Tennessee Products Corp., at a dinner at the Belle Meade country club.

Saturday morning the party was taken to Lyle, Tenn., to visit the Wrigley furnace. A wood distillation plant, carbonizing 200 cords of wood per day is co-ordinated with this furnace. The wood distillation plant supplies charcoal fuel for the furnace and a number of by-products used in various manufacturing industries. The trip ended with a banquet at the Andrew Jackson hotel.

Book Review

Manuel des Laboratoires Siderurgiques, 310 pages, 5¾ x 8¾ inches, published by Office de Publicite, Brussels, Belgium, and supplied by THE FOUNDRY, Cleveland for $1.60, and in London, 2-3 Caxton House, Westminster, for 5s 6d.

This volume contains the analytical methods which are agreed upon by the corporation of Arbed Terres Rouges, Belgium, and authorized by the laboratory commission. The first chapter is devoted to rules of sampling materials which is followed by methods for analyzing iron and steel. Methods for the qualitative analysis of special steels are presented, followed by those for the quantitative estimation of the various elements. Chapters are devoted to the analysis of ferroalloys, brasses and bronzes, metallic cobalt, aluminum, silico-aluminum, blast furnace slags, open-hearth slags, flue dust, manganese ore, limestone, dolomite and magnesia, fluorspar, refractories, etc. Methods for the analyses of foundry sand, cement, water, pitch, lubricating oils, coal, the reactivity of coke, gas and ammonium sulphate also are given. At the end of the volume 38 pages are devoted to the costs of performing the various analyses and the average price for the determination of each element. This average price is based on a large number of experiments performed. The book is printed in French.

Air Equipment Required for Brass Shop

Question: We are building a brass foundry in which we propose to install a compressor 8 x 13 inches. Do you think this compressor is too large to supply two molding machines and a sandblast? Will a 25-horsepower motor drive this together with a bandsaw a tumbling barrel and a grinder?

Answer: Speaking offhand in a general way the equipment you itemize conforms to that found in the small jobbing brass shop. In fact unless your machines and sandblast are larger than those usually found in the average brass shop, a smaller compressor and a smaller motor would suffice. However, before finally deciding on the equipment, a great many factors have to be taken into account, factors that do not appear in your inquiry and factors that are actually essential to the preparation of a definite answer. For all we know to the contrary you may contemplate installing second hand equipment and if that is the case allowance must be made for its condition.

Some molding machines take considerably more air than others and the sandblast nozzles must be watched closely and changed when they show signs of wear. A worn sandblast nozzle will dissipate air at an alarming rate. Preferably an individual pipe line with a small storage tank should be provided for the molding machines. If the molding machine line merely is tapped from the main that supplies the sandblast, trouble may be experienced in securing sufficient pressure for the molding machines while the sandblast is in action. Instead of guessing on the equipment required, we suggest you consult the makers of the different pieces. The molding machine men will tell you the amount and pressure of air required, the sandblast maker will inform you of the requirements of his machine, you can readily find the capacity of a compressor of any given size, together with the horsepower required to operate it. With these definite figures before you, an intelligent choice readily may be made.

Publishes New Catalog

The Diamond Clamp & Flask Co., Richmond, Ind., has published a 44-page, pocket size catalog describing its various types of snap flasks, steel jackets, adjustable clamps, wood core boxes, steel bottom boards and other equipment. The catalog is illustrated well and the sizes and prices of the materials are given.

American Industry Combines To Span the Atlantic

WITH Col. Charles A. Lindbergh back on United States soil receiving the plaudits of the American people, industrial men have become interested in the construction of the plane which made possible the greatest achievement of the century. The community of interest exemplified in the construction of "Spirit of St. Louis" with its many ramifications touches the most important industries of the country.

Analysis of the use of the materials in Lindbergh's plane reveals the dominating importance of alloy steel and aluminum. These and other materials were employed in one or more of the three essential units of the "Spirit of St. Louis"—the plane proper, the engine and the instruments upon which much depended.

Lindbergh's choice of ship was a monoplane designed and built by Ryan Airlines, Inc., San Diego, Calif. It was practically a stock model, except that it was modified in order to carry the extra heavy load of fuel without greatly increasing the wing area.

The propeller, 9 feet from tip to tip and weighing 25 pounds, is of aluminum alloy. It is mounted on a 20-pound, heat treated alloy steel hub.

A partial list of companies contributing parts or service to the construction of the plane proper is presented here through courtesy of Ryan Airlines, Inc., builder of the "Spirit of St. Louis":

Aluminum sheets, tubing and virgin metal .....Aluminum Co. of America, Pittsburgh
Propeller .....Standard Steel Propeller Co., Pittsburgh
Steel wire .....John A. Roeblings Sons Co., Trenton, N. J.
Alloy steel tubing .....Summerill Tubing Co., Bridgeport, Pa.
Lumber .....Sullivan Hardwood Lumber Co., San Diego, Calif.
Veneer .....California Panel & Veneer Co., Los Angeles, Calif.
Sheet metal fabrication .....Standard Sheet Metal Works, San Diego, Calif.
Glasswork .....W. P. Fuller & Co., San Diego, Calif.
Valves.....Lunkenheimer Co., Cincinnati
Wire wheels .....Dayton Wire Wheel Co., Dayton, O.
Tires.....B. F. Goodrich Rubber Co., Akron, O.

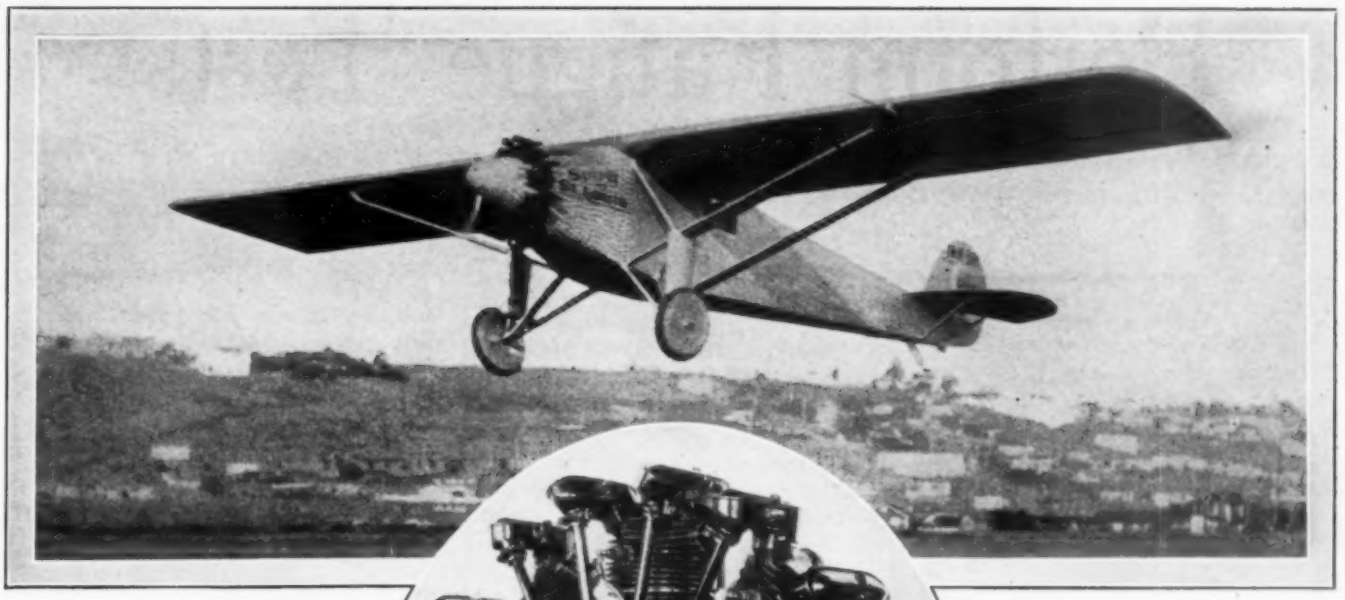
Lindbergh's engine is a stock model of the J-5 type made by the Wright Aeronautical Corp., Paterson, N. J. It is a nine-cylinder, air-cooled radial engine of 4½-inch bore and 5½-inch stroke. The cast aluminum crankcase is divided vertically into three sections, the valve gear chamber, crankcase proper and induction chamber. The crankshaft is an alloy steel forging and has a single counterweighted throw. Eight auxiliary connecting rods are linked with the master rod at its largest end. Each cylinder consists of a cast aluminum head and jacket. A steel sleeve which is screwed into the jacket has a holddown flange for attachment to the crankcase. Each jacket is finned for aircooling.

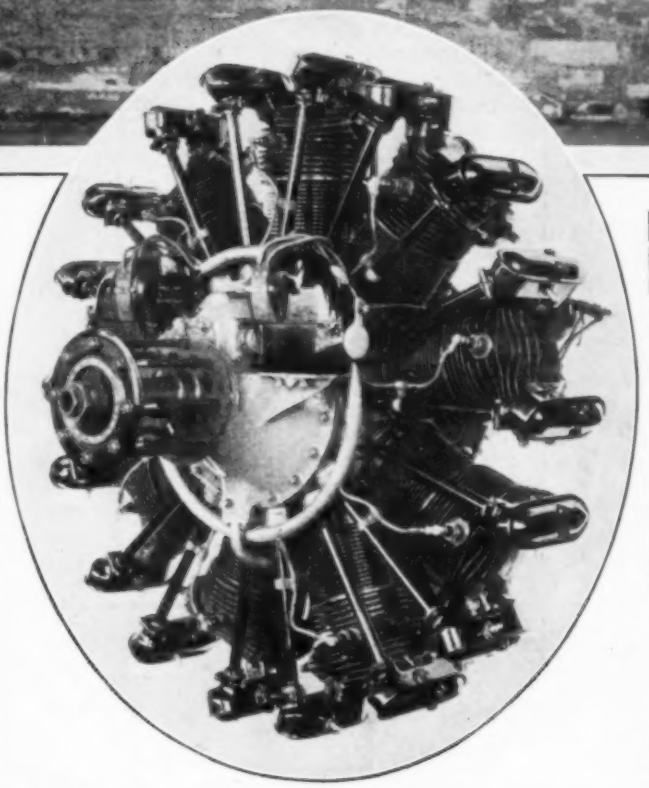
The following is a partial list of companies participating in the construction of Lindbergh's motor.

Nonferrous Metals, Castings, Forgings

Aluminum for castings, Aluminum Co. of America, Pittsburgh; aluminum bronze for castings, American Brass Co., Waterbury,

Modern Motor Efficiency is shown by the fact that Lindbergh's monoplane flew 6200 miles before the 3647-mile New York-Paris flight with no repairs. Lindbergh is shown pointing to the propeller hub during an inspection of the machine.





Lindbergh's machine was equipped with this nine-cylinder, air-cooled motor, radial type, rated at 200 horsepower, and weighing 508 pounds

Conn.; bronze for counterweights, Bearium Bearings, Buffalo; connecting rod bearings, Bohn Aluminum & Brass Co., Detroit; crankcase bearing ring bronze castings, Lumen Bearing Co., Buffalo; laminated brass shim, Laminated Shim Co., Long Island City, N. Y.; bronze bars, copper and bronze tubing, Chase Companies Inc., Waterbury, Conn.; brass primer fittings, Lunkenheimer Co., Cincinnati; brass compressor fittings, Parker Appliance Co., Cleveland; drawn bronze bars, Sumet Corp., Buffalo; brass ignition wire markers, Standard Metal Mfg. Co., Newark, N. J.; high tension ignition cable, Acme Wire Co., New Haven, Conn.

Ball and Roller Bearings, Etc.

Roller bearings, Norma-Hoffmann Bearings Corp., Stamford, Conn.; ball bearings, S. K. F. Industries, New York; thrust bearing, Standard Steel & Bearings Inc., Plainville, Conn.; setscrews, Allen Mfg. Co., Hartford, Conn.; plugs for core holes, M. D. Hubbard Spring Co., Pontiac, Mich.; steel ball joints, Cincinnati Ball Crank Co., Cincinnati; screws, Parker-Kalon Corp., New York.

Lubrication fittings, Bassick Mfg. Co., Chicago; spark plugs, A. C. Spark Plug Co., Flint, Mich.; oil strainer assembly, Industrial Electric Mfg. Co., Wayne, Mich.; spark plug terminals, Rajah Co., Bloomfield, N. J.; carburetor, Stromberg Motor Devices Co., Chicago; impregnated paper gaskets, Vellumoid Co.; Boston; ignition switch, Splitdorf Electric Co., Newark, N. J.; magnetos, Scintilla Mfg. Co., Sidney, N. Y.; gray iron piston rings, U. S. Hammered Piston Ring Co., Irvington, N. J.; rubber packing, U. S. Rubber Co., New York and Manhattan Rubber Co., Passaic, N. J.; fiber and asbestos gaskets, Victor Mfg. & Gasket Co., Chicago.

Miscellaneous

Gray iron fuel pump castings, Capitol Foundry Co., Hartford, Conn.; enamel for crankcase, Kay & Ess Co., Dayton, O.; baking japan for cylinders, Hilo Varnish Corp., Brooklyn, N. Y.

Early newspaper reports of the flight stated that Lindbergh was depending upon an ordinary compass for his bearings. As a matter of fact his plane was equipped with an unusually efficient set of navigating instruments including an air-speed indicator, a turn indicator, altimeter, magnetic compass and the well known earth inductor compass. The latter comprises an indicator, a controller, and a generator which is driven by a windwheel mounted on top of the fuselage about halfway back from the instrument board. All of the instruments are of the round dial type and were manufactured by the Pioneer Instrument Co., Brooklyn, N. Y. This company has furnished the following partial list of companies which supplied material for the instruments:

Steel Products

Swedish music wire, Peter A. Frasse & Co., New York; Swedish flat spring wire, Edgar T. Ward's Sons Co., Newark; flat spring wire, Wallace Barnes Mfg. Co., Bristol, Conn.; English ball bearing balls, C. & C. Sales Co., New York; ball bearings, Norma-Hoffmann Bearings Co., Stamford, Conn., and S. K. F. Industries, New York.

Nonferrous Products

Duralumin sheets, tubes and rods, Aluminum Co. of America, Pittsburgh; brass and bronze sheets, rods and tubes, Chase Companies Inc., Waterbury, Conn.; coin silver, Handy & Harmon, New York; copper wire, Belden Mfg. Co., Chicago; die castings, Doehler Die Casting Co., Brooklyn, N. Y. and Marf Machine & Die Casting Co., New York.

Miscellaneous

Name plates and instrument faces, Premier Metal Edging Co., Long Island City, N. Y.; radium paint, United States Radium Corp., New York and Starkey Dial Co., New York; paints and varnishes, Hilo Varnish Co., Brooklyn, N. Y.; Standard Varnish Co., New York; Sherwin-Williams Co., Cleveland, G. J. Nickols Co., Chicago and E. I. Dupont de Nemours Co., Wilmington.

From the foregoing it is evident that almost every activity in our present industrial structure was drawn upon to make possible the flight. All of the plants which contributed directly to the venture, in turn draw upon all other industries for materials and equipment.

It is impossible to estimate the number of men whose work to some extent was entailed in making materials and parts that went into Captain Lindbergh's plane. For instance, Wright Areonautical Corp. has 650 men on its payroll, all of whom participated in some way in the production of the engine. The Pioneer Instrument Co. has about 100 employes, all of whom are engaged in making aviation instruments and so on down the line.

Perform Fatigue Tests

Cast Iron Is Subjected Occasionally to Repeated Stress in Service—These Data Show a Well-defined Fatigue Limit, Low Both in Value and in Comparison with Static Tensile Strength

By H. F. Moore and S. W. Lyon

IN ANY study of the strength of cast iron, or of any cast metal, two distinct problems are to be recognized: (1) the study of cast iron as a material, and (2) the study of the effective strength of the material in different parts of a casting. The second problem is modified by such factors as internal strains, minute cracks, varying rate of cooling of different parts of casting, inclusions of dirt and slag, and the form assumed by the flakes of graphite in the cast iron. Strength of cast iron as a material, may best be studied by means of tests of specimens cut from castings of simple shape, and cast under carefully controlled foundry conditions, since in such parts the cast iron is most uniform in quality and the effects of irregularities are least. It is evident that the study of the effective strength of cast iron in different parts of complicated castings would be a much more difficult matter. In this paper it is the first problem which is studied rather than the second.

Data Is Valuable

FEW test data on the strength of cast iron under repeated stress are available. Through a co-operative arrangement between the University of Illinois and the Allis-Chalmers Mfg. Co., a short investigation was carried on in this field. The data included in this article will be of interest to foundrymen who may be incited to study the matter further and develop cast irons that may give higher values. This article is abstracted from a paper presented at the American Foundrymen's convention held in Chicago June 6 to 10. Mr. Moore is research professor of engineering materials and Mr. Lyon is engineer of tests, in the department for investigation of fatigue of metals, University of Illinois, Urbana, Ill.

The four different lots of cast iron tested hereafter are referred to by the laboratory numbers 91, 92, 93 and 94, assigned for purpose of identification. Test specimens for cast iron 91 were cut from a section of 6-inch cast iron pipe purchased on open market. The centrifugal casting process in horizontal refractory sand molds was used in the fabrication of this pipe. Fig. 1 shows the location of specimens in a section of pipe.

Cast irons 92 and 93 were obtained from hollow cylindrical castings supplied by the Allis-Chalmers Mfg. Co. Both cylinders had narrow flanges at one end and were cast in green sand molds having dry sand cores. The approximate wall thicknesses of the cylinders for cast irons 91 and 92 were one and three inches, respectively. Figs. 2 and 3 show in detail the size

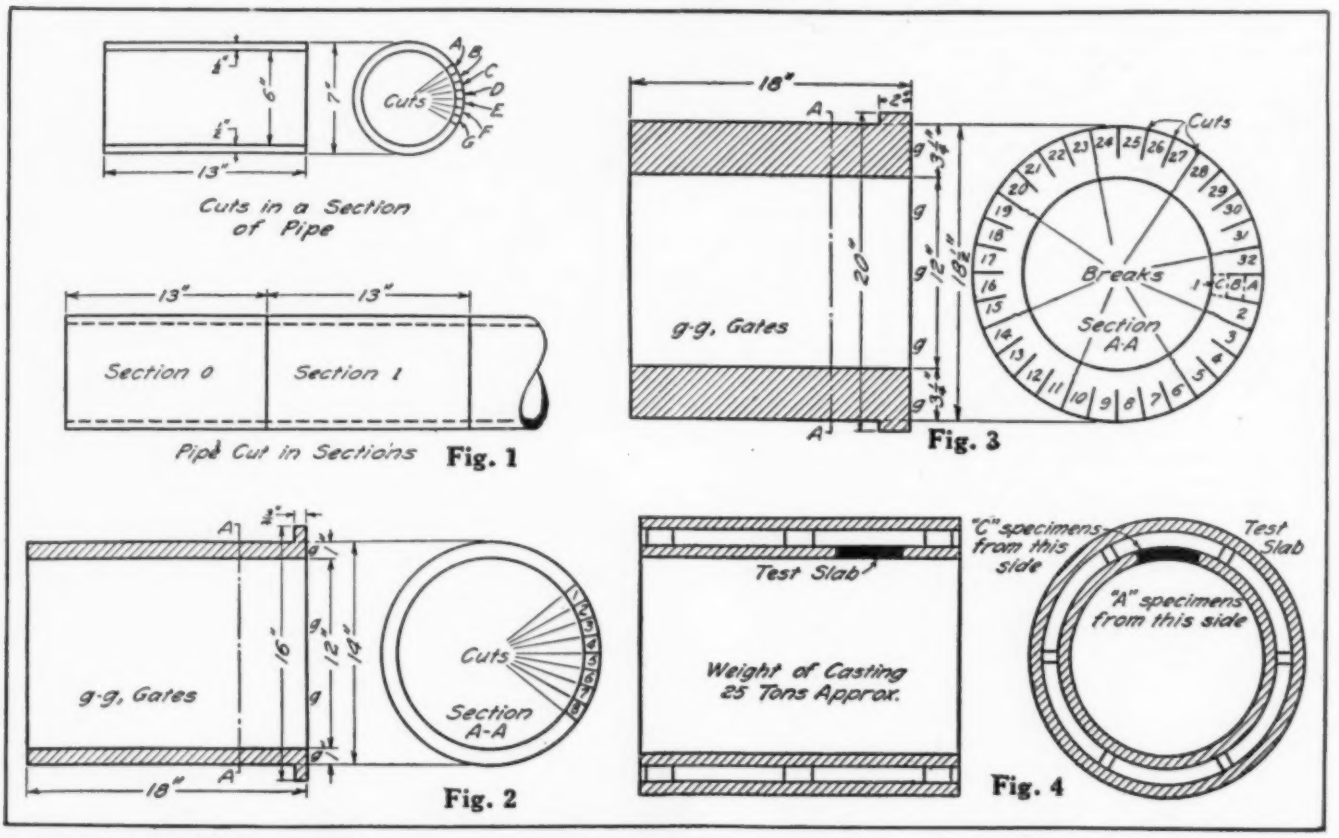


FIG. 1—DIAGRAM SHOWING METHOD OF CUTTING PIPE AND LOCATION OF SPECIMENS. FIG. 2—LOCATION OF SPECIMENS AND METHOD OF CUTTING THE CYLINDER. FIG. 3—THE HEAVY CYLINDER WAS CUT ACCORDING TO THE DIAGRAM. FIG. 4—SHOWING THE LOCATION OF SPECIMENS FROM THE DOUBLE-WALLED CASTING

and shape of the castings tested.

The slab from which cast iron 94 was obtained was cut from the inner wall of a double-wall cylinder casting weighing approximately 25 tons. Fig. 4 shows the general location of the slab from which specimens were obtained. Specimen *A* is the outer surface, *B* the center and *C* the inner surface of the casting.

The chemical compositions of cast irons 91, 92, 93 and 94 are given in Table I. The analyses may be considered fairly representative of good gray cast iron. The existence of practically all of the carbon in cast iron 94 in the graphitic form is especially worthy of note.

Fairly extensive microscopical examination of unetched specimens of the various irons showed no appreciable segregation of graphite. The micrographs shown in Fig. 5 were taken at a magnification of 75 diameters and are believed to show representative graphite distribution for the various cast irons tested.

Supplementary microscopical studies of etched specimens were made for the irons tested. The micrographs of Fig. 6 show representative areas and were taken at a magnification of 750 diameters. Fig. 6 indicates that for cast irons 91, 92 and 93 lamellar pearlite is the dominant crystalline constituent present. This dominance of pearlitic structure is to be expected with these irons as the amounts of combined carbon would indicate from 50 to 95 per cent pearlite (excluding effect of silicon, etc.). Occasional grains of steadite, which is a phosphide eutectic are discernible surrounded by the lamellar pearlitic structure.

Cast iron 94 cooled much more slowly than the other irons tested due to the large mass of the casting, thus causing the carbon to be deposited almost entirely in the graphitic form, as indicated by the chemical analysis. As can be seen from Fig. 6 ferrite is the dominant crystalline constituent, with scattered areas of pearlite in evidence, usually around occasional grains of steadite. These scattered areas of pearlite in a ferrite matrix are to be expected as the chemical composition indicates some 5 per cent pearlite. This pearlite varies from

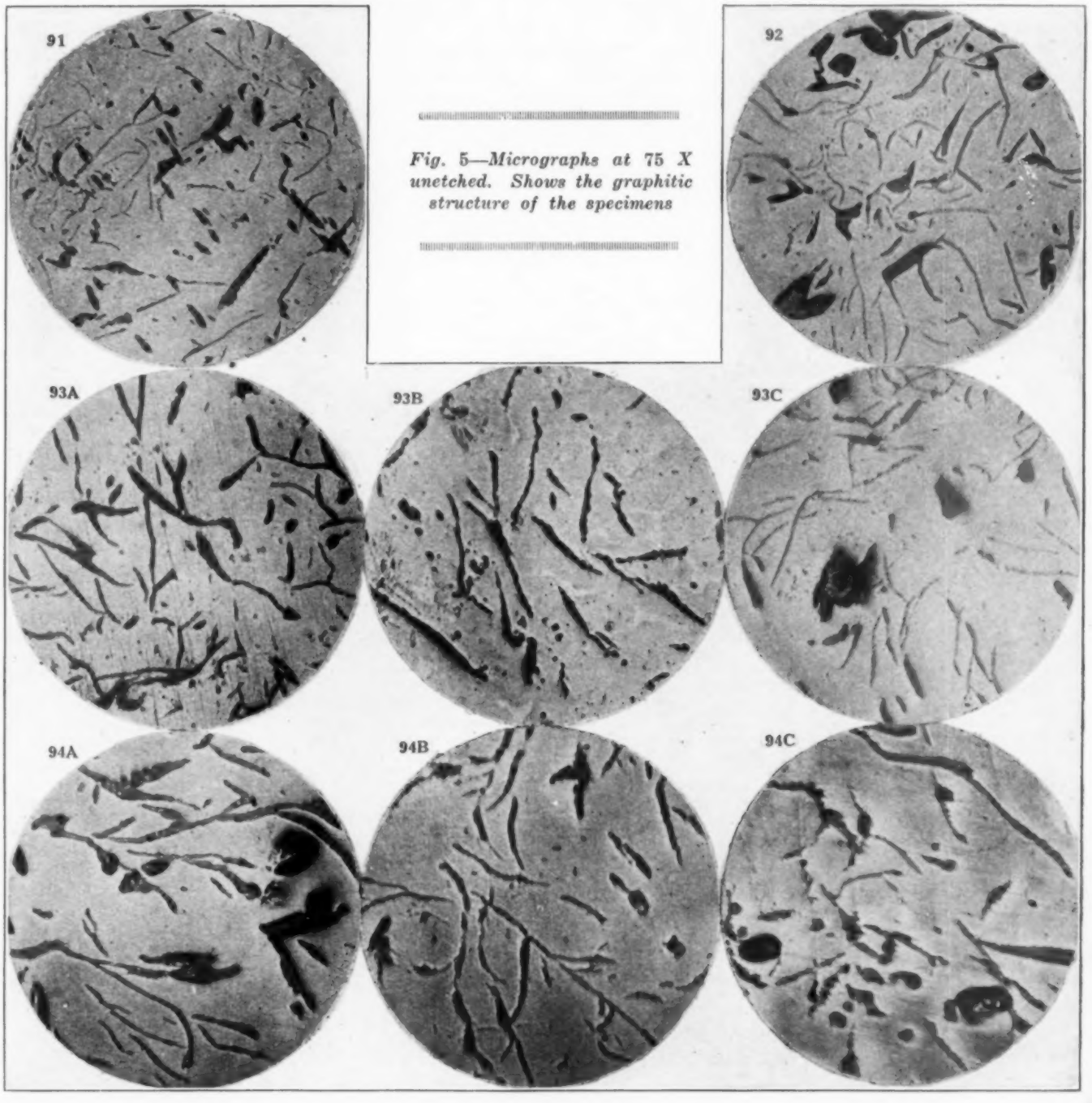


Fig. 5—Micrographs at 75 X unetched. Shows the graphitic structure of the specimens

the lamellar form to the globular, with the transition stages in evidence.

All the irons were tested as cast. No special heat treatment was applied either at the foundry or in the laboratory. Cast iron 91 was allowed to cool in the mold, not shaken out while still hot, as is quite common practice for centrifugal-cast pipe.

Test bars were cut from the pieces of iron supplied as shown in Figs. 1, 2, and 3. These test bars were then cut up into specimens for static tension tests, for Charpy notched-bar tests, for repeated-impact tests and for rotating-beam fatigue tests. The form and size of the specimens used is shown in Fig. 7. It should be noted that since the thickness of wall of the pipe from which the specimens of cast iron 91 were cut was only ½ inch it was necessary to make the tension specimen and the rotating-beam specimen for cast iron 91 slightly smaller than those shown in Fig. 7. The tension specimens of cast iron 91 were made 0.3 inch minimum diameter, and the rotating-beam specimens were made 0.325 inch minimum diameter and 0.400 inch maximum diameter.

The tension tests were made on a 100,000 pound 3-screw testing machine manufactured by the Tinius Olsen Testing Machine Co. The tension specimens were specially designed to avoid stress-concentration near the critical section. They were held in shackles, developed by Robertson in the *Report*, British Aeronautical Research committee, 1921 and shown in Fig. 8, which are designed to minimize flexural action on the specimen. In the case of cast iron, 91 tests, with specimens as shown in Fig. 7 (b), held in this type of shackle, raised the value obtained for ultimate tensile strength about 12 per cent above that obtained for specimens having parallel sides and held in ordinary spherical-seated shackles.

Charpy impact tests were made on a 30 meter-kilogram testing machine designed by Sauveur and Boylston. Repeated-impact tests were made on a special double-hammer machine built in the shops of the department of theoretical and applied mechanics of the University of Illinois.

The fatigue tests were all made on

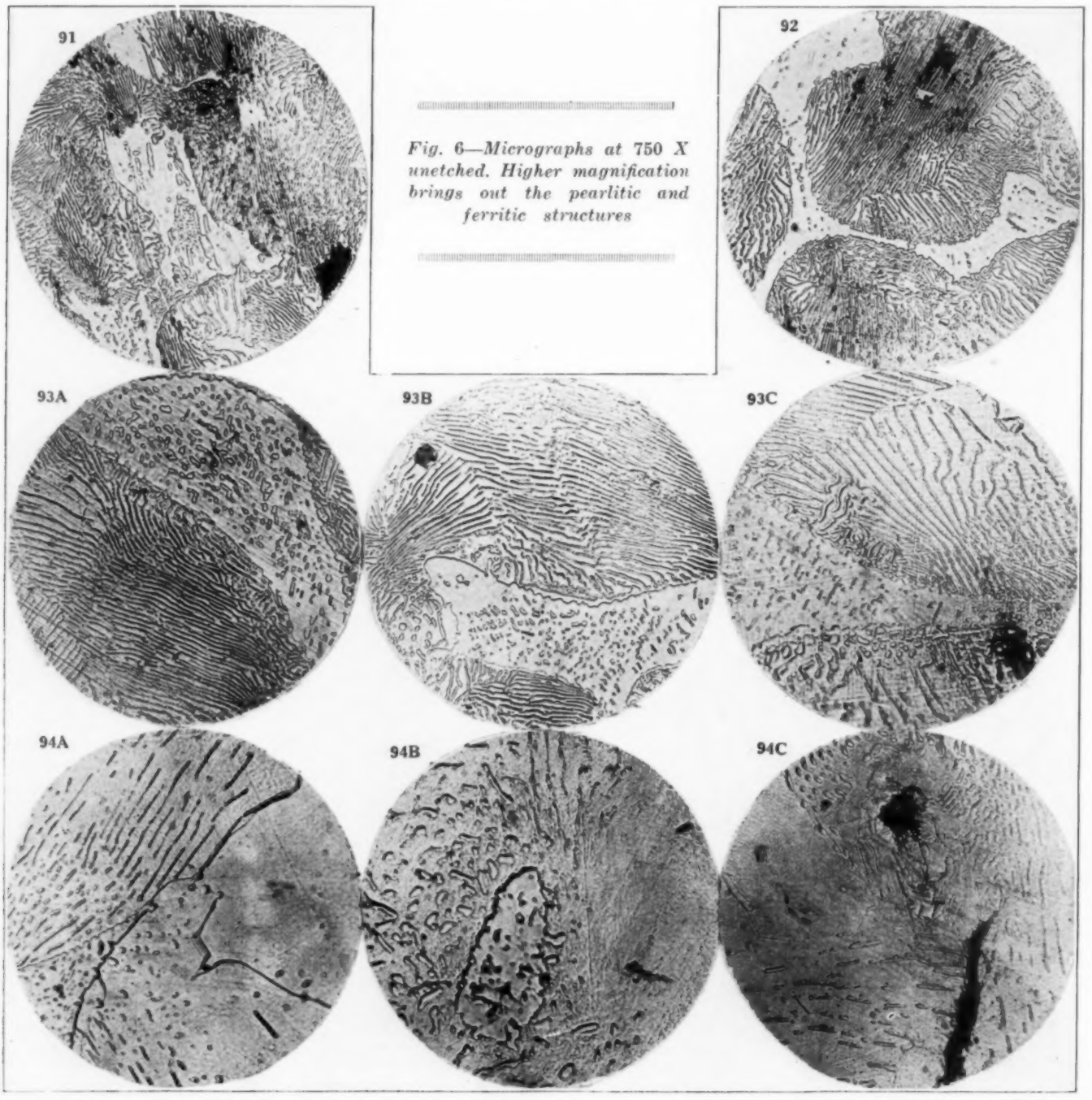


Fig. 6—Micrographs at 750 X unetched. Higher magnification brings out the pearlitic and ferritic structures

rotating-beam testing machines such as those shown in diagram in Fig. 9. These machines subject the specimen to cycles of reversed bending, and the bending moment is uniform between *C* and *D*.

Results of Static Tests

The results of the static tension tests are given in Table II and typical stress-strain diagrams are given in Fig. 10. No well-marked proportional elastic limit and no yield point was developed for any tension specimen. The elongation after fracture and the reduction of area for tension test specimens were too small to be measured.

Table II also gives the results of the brinell hardness tests. In the brinell tests a standard 10-millimeter ball was used, but the load used was 1,000 kilograms. The brinell number for a given diameter of impression was taken as one-third that given in the United States bureau of standards reduction tables for a 3,000 kilogram load.

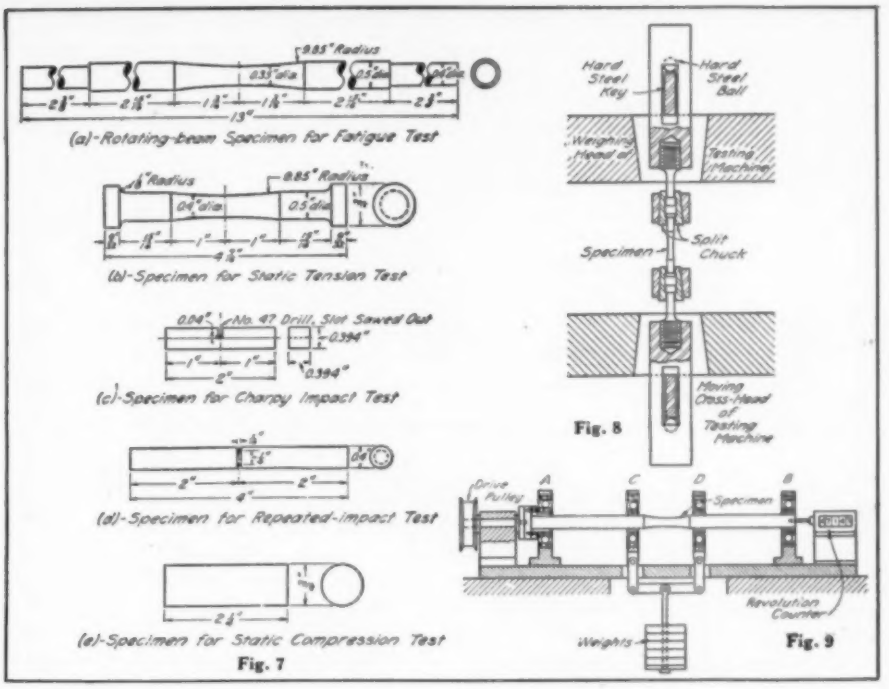


FIG. 7—DIMENSIONS OF THE SPECIMENS ARE AS SHOWN. FIG. 8—SHACKLES DESIGNED TO MINIMIZE FLEXURAL ACTION. FIG. 9—VIEW OF THE ROTATING BEAM MACHINE

Table I

Compositions of Cast Irons Tested

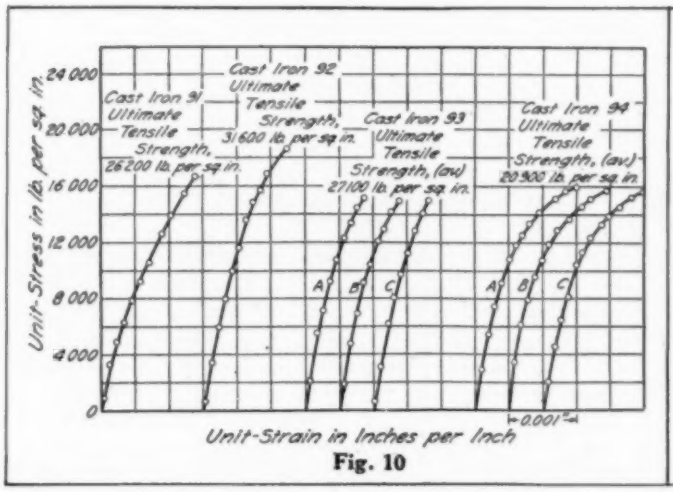
Cast Iron Lab. No.	Content, per cent						
	Silicon	Sulphur	Phosphorus	Manganese	Graphite Carbon	Combined Carbon	Total Carbon
91	1.42	0.065	0.75	0.32	2.72	0.84	3.56
92	1.10	0.093	0.51	0.62	2.76	0.68	3.44
93A	1.10	0.095	0.51	0.63	2.80	0.55	3.35
93B	1.10	0.094	0.51	0.59	2.78	0.57	3.35
93C	1.10	0.096	0.46	0.60	2.82	0.43	3.25
94A	1.16	0.102	0.38	0.58	....*	....*	3.32
94B	1.14	0.100	0.38	0.61	....*	....*	3.30
94C	1.13	0.103	0.40	0.57	....*	....*	3.30

*Combined carbon was less than 0.05 per cent, nearly all carbon was graphite.

Charpy notched-bar values obtained are given also in Table II. Each value reported is the average of results of tests on from four to six specimens. It will be noted that, as might be expected for cast iron, the Charpy values are low, as compared with those for steel, with the exception of cast iron, 92. Charpy values for normalized machine steel of 14 foot-pounds, and for a heat-treated alloy steel of 45 foot-pounds are not unusual.

Results of Fatigue Tests

The results of fatigue tests of any metals best can be shown by a diagram in which values of computed stress are plotted as ordinates and values of number of cycles of stress required to cause fracture are plotted as abscissas. Such a diagram is known as *S-N* diagram or stress-cycle diagram. Figs. 11, 12 and 13 shows the *S-N* diagrams for the fatigue tests of cast iron. They are plotted to logarithmic coordinates, which have been found convenient to use, but which have no other special significance. It will be noted that the *S-N* diagrams all appear to become horizontal. For a stress less than that


Unit-Stress in lb. per sq. in.
Cast Iron 91 Ultimate Tensile Strength, 26200 lb. per sq. in.
Cast Iron 92 Ultimate Tensile Strength, 31600 lb. per sq. in.
Cast Iron 93 Ultimate Tensile Strength, (av) 27100 lb. per sq. in.
Cast Iron 94 Ultimate Tensile Strength, (av) 29900 lb. per sq. in.
A
B
C
0.001"
Unit-Strain in Inches per Inch
Fig. 10

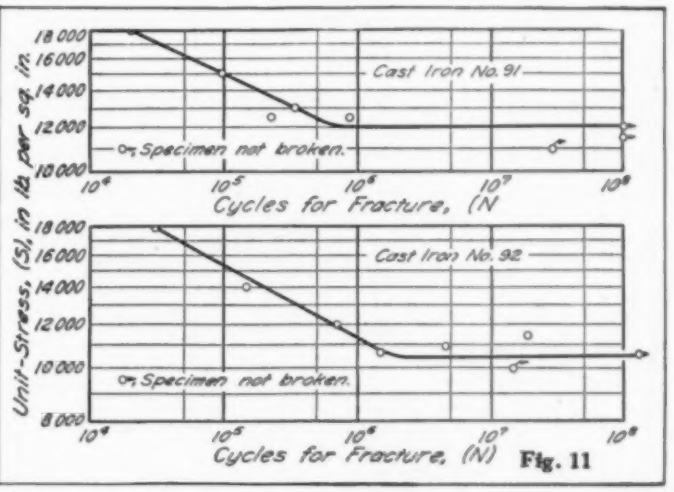


FIG. 10—TYPICAL DIAGRAMS OF STATIC TENSION TESTS. FIG. 11—STRESS-STRAIN DIAGRAM FOR THE FATIGUE TESTS

Table II

Results of Fatigue and Other Tests on Cast Iron

Cast Iron, Lab. No.	Static Tension Tests, Pounds Per Square Inch: Proportional Elastic Limit	Yield Point	Ultimate Tensile Strength	Ultimate Compressive Strength, Pounds Per Square Inch	Charpy Tests (Notched-Bar), Foot Pounds	Repeated-Impact Tests No. of Double Blows	Brinell Number	Fatigue Tests*: Endurance Limit, Pounds Per Square Inch	Endurance Ratio†
91	Not clearly defined.		26,200	96,000	4.0	1	162	12,000	0.46
92	Not clearly defined.		31,600	111,000	11.8	1	148	10,500	0.33
93A	Not clearly defined.		28,100	94,000	2.7	1	138	10,600	0.36
93B	Not clearly defined.		25,300	85,000	2.2	1	132	9,000	0.36
93C	Not clearly defined.		28,000	87,300	2.5	2	139	10,000	0.36
94A	Not clearly defined.		21,400	82,500	1.6	3	89	7,000	0.33
94B	Not clearly defined.		20,700	83,500	1.6	4	91	7,200	0.35
94 C	Not Clearly defined.		20,500	82,000	1.5	3	88	7,800	0.38

*All fatigue tests were made on rotating-beam testing machines. †The ratio of endurance limit to ultimate tensile strength.

for which the diagram becomes horizontal, so far as can be seen, the metal is able to withstand an indefinitely large number of cycles of stress. This limiting stress corresponding to the horizontal part of the diagram is called the *endurance limit* or the *fatigue limit*, and is regarded as the best index of the ability of the metal to withstand repeated stress. The results of the fatigue tests are also given in Table II.

For wrought iron and wrought steel the endurance limit is usually found at about one-half of the ultimate tensile strength. It will be noted that for the cast irons tested the endurance limit was found distinctly below this ratio.

Several series of special tests were made. Specimens of cast iron tested under cycles of stress not completely reversed but varying from zero to a maximum gave an endurance limit about 40 per cent greater than the endurance limit under completely reversed stress.

Specimens of cast iron in which sharp notches had been turned were tested under reversed bending, and the endurance limit of such specimens was but little less than the endurance limit of cast iron specimens without sharp notches. For steel specimens, especially for heat-treated alloy specimens, the relative effect of notches is much higher than for cast iron. The graphite flakes and other inherent irregularities of structure in cast iron seem to weaken it so much that such additional damage as is caused by notches is not serious.

A few fatigue tests of cast iron were made at elevated temperatures. The fatigue strength did not show any appreciable falling off up to a temperature of 600 degrees Fahr.

The outstanding result for this short investigation is that each of four lots of cast iron tested showed a well-defined fatigue limit, although this limit was low, both in pounds per square inch and in comparison with the static tensile strength.

Figs. 12 and 13—Stress-strain diagrams for the fatigue tests. The specimen number is marked on each diagram

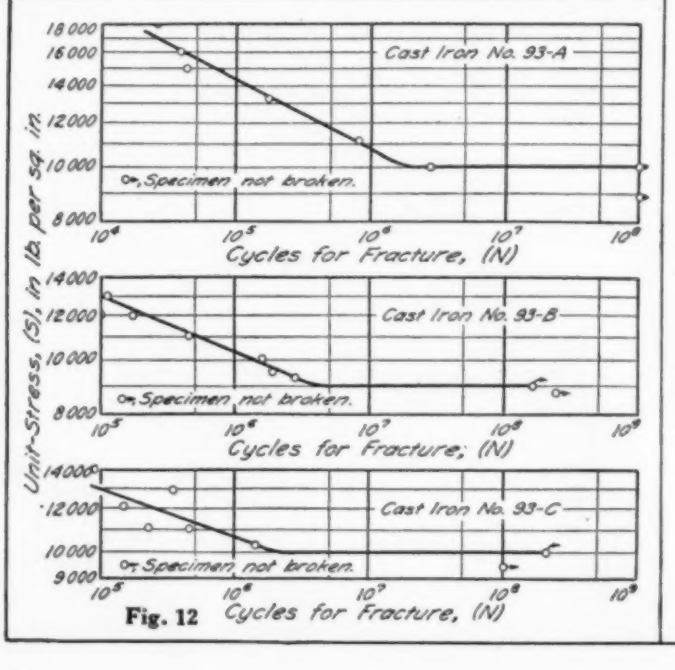


Fig. 12

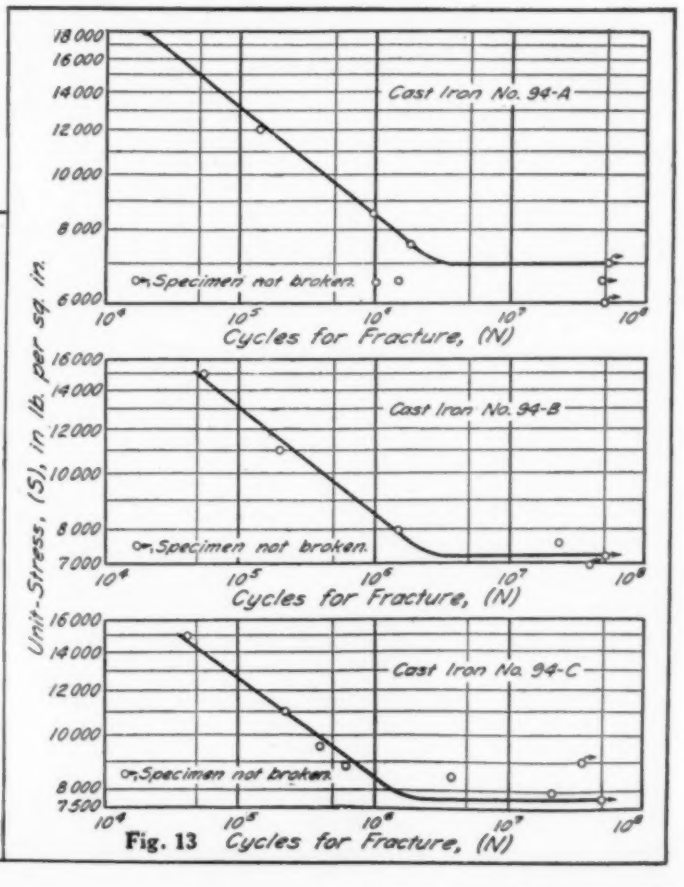


Fig. 13

Will Return Exhibit Material Free

In view of the interest which is attached to the foundry exhibition to be held in Paris next September, the Compagnie Generale Transatlantique has informed the organizers of the exhibition that it is disposed to return to the country of origin, the material exhibited, free of charge.

Egan, Webster & Co. Inc., fire clay, firebrick and sand producer, has removed its office to 50 Broadway, New York.

Payment will be made for all contributions on foundry and pattern shop practice suitable for publication

A LEXICON OF TECHNICAL TERMS

(*Continued from Data Sheet No.* 672)

Malleability

The capability of being permanently deformed without rupture by pressure, for example, as by hammering.

Wrought iron and steel are malleable.

Malleable cast iron is malleable to a lesser degree than steel.

Cast iron is malleable slightly if any. (Iron is the ninth in the malleability scale of metals and alloys).

Rigidity (*Stiffness*)

The property of a substance by which bodies resist change in shape.

Tenacity (*Cohesiveness*)

The property of resistance to rupture or separation of parts. This property is usually referred to as tensile strength.

Brittleness (*Shortness, Fragility*)

The property of breaking without much permanent deformation. This usually is understood to be the result of suddenly applied stresses. Brittleness is the opposite of toughness.

High carbon and quenched steels are brittle.

White iron is brittle.

Cast gray iron is also brittle.

Mechanical brittleness is exhibited when a piece of metal snaps off on any attempt to bend it.

Potential or *vibratory brittleness* is exhibited when a metal will give excellent tensile tests, will bend double readily without fracture, but is nevertheless likely to fracture suddenly on vibratory or alternating stresses below the elastic limit.

Intermittent brittleness is exhibited when either brittleness or toughness may be produced by vibratory or alternating stresses.

Stead's brittleness occurs rarely and is produced by heating low carbon steel for a long time (days) to between 500-750 degrees Cent. (930-1380 degrees Fahr.).

Slag shortness (brittleness) is due to slag inclusions.

Brittleness, according to LeChatelier, may be due to two different causes; the nature of the metal and external conditions.

Nature of the metal which includes chemical composition, chemical constitution, the structure, more in particular as affected by mechanical treatment, cold work, heterogeneity, slag enclosures, segregation, etc.

External conditions which include rate of loading, temperature when under stress, form or shape of piece, and diverse causes, such as vibration in conjunction with steady loading, etc.

(*Continued on Data Sheet No.* 674)

Note—This sheet may be cut into two sections, 5 x 7 inches, and may be readily bound in note book form.

A LEXICON OF TECHNICAL TERMS

(*Continued from Data Sheet No.* 673)

Toughness

The total energy or work expended to break (rupture) a material, or the property of being difficult to break. Wrought iron, low carbon and alloy steels are quite tough.

In treating steels to produce toughness it usually is understood to be certain treatments of medium carbon steels which will produce both strength and toughness. By various heat treatments it is possible to get varying degrees of toughness. To properly heat treat, the specimens must be quenched from the proper critical temperature to refine the grain and then drawn sufficiently to remove quenching strains and produce 100 per cent uniform sorbite. The sorbitic structure gives the best combination of *toughness*, *strength*, and *ductility*.

To differentiate the different quenching mediums, the terms *air toughening*, *water toughening*, and *oil toughening* are used.

An example of the effects of toughening by heat treatment is given in the accompanying table.

Effect of Various Treatments

Heat Treatment		Physical Tests					
Hardening and refining, Deg. C.	Anneal and draw, Deg. C.	Tensile strength	Elastic limit	Per cent elongation in 2 inches	Per cent reduction in area	Brinell number	Scleroscope test
As rolled	.....	85,000	50,000	30.0	48.9	163	25
Heated to 760 and cooled in furnace	.....	74,000	42,500	32.0	54.7	134	23
Heated to 815	427	100,000	67,000	21.0	53.9	179	30
Quenched in oil	482	98,000	66,000	23.5	52.8	170	29
	538	90,000	59,000	26.5	54.7	170	29
	593	89,000	58,000	26.5	63.5	170	29
	649	75,000	53,000	33.5	64.7	156	27
	704	71,000	51,000	34.0	59.3	137	25
Heated to 815	427	110,000	81,000	19.0	46.0	223	35
Quenched in water	482	103,000	71,000	22.5	54.7	192	33
	538	95,000	68,500	23.5	61.6	187	32
	593	89,000	63,000	28.5	63.0	179	29
	649	82,000	57,500	30.5	65.4	156	26
	704	73,000	51,000	34.0	59.8	143	25

Chemical composition: Carbon, 0.38 per cent; manganese, 0.55 per cent; silicon, 0.05 per cent; phosphorus, 0.024 per cent; sulphur, 0.05 per cent. Description of pieces treated: One inch rounds, 29 inches long, 14 pieces, all from the same billet. One test piece from each of the 14 pieces, turned to a diameter of ½ inch.

(*Continued on Data Sheet No.* 677)

Seeing America with The Foundry

Little Journeys to the homes of our readers

IOWA has a total of 99 foundries of which

85 Melt Gray Iron
7 Melt Steel
1 Melts Malleable Iron
8 Are Exclusive Brass
47 Have Nonferrous Departments and
39 Melt Aluminum

IOWA—first settled by Marquette and Joliet in 1673 is almost equally distant from the Atlantic and the Pacific Oceans and is midway between the North Pole and the equator.

In the value of its horses and hogs, as well as in the total value of all domestic animals, Iowa leads all other states. Iowa produces twice as many hogs as any other state. The annual production of butter is about 130,000,000 pounds and two thirds of this is shipped to other states. Over ninety-seven per cent of the surface of Iowa is included in farms, and of this area over eighty-six per cent is improved. Nearly the entire state is covered with a deep, rich soil and is easily tilled. Iowa is one of the leading agricultural states of the Union. Corn is the chief crop and the annual crop is over 370,000,000 bushels placing this state first among the corn growing states. Large quantities of apples, grapes, cherries and other fruits are produced. The state contains an abundance of grass land for pasturage and the growing of hay. This with the large crops of corn and other cereals and abundance of pure water, especially adapts Iowa to stock raising and this branch of agricultural industry is very important. Large numbers of draft and driving horses are also raised, as are swine and sheep. The dairy industry is also important and is of such magnitude as to place Iowa in the front rank as a dairy state.

The manufacturing industries are limited, because of the great advantages in agriculture. The most important manufacturers are those pertaining to meat packing, butter, cheese and condensed milk, farm implements and machinery, pottery, glucose and food products, such as syrup and canned goods. The value of the goods manufactured is about $265,000,000.

In IOWA THE FOUNDRY has 88 paid subscribers

"Wherever metals are cast you'll find THE FOUNDRY"

Not What Price, But

WHAT QUALITY IRON?

Growing Tendency Among Blast Furnace Operators To Add Scrap to the Burden Has Introduced New Complications in the Task of Judging the Value of Pig Iron

By Dr. Richard Moldenke

DESIRABILITY of fixing upon some standard method of evaluating the quality of foundry pig irons first was brought to the attention of the industry by the writer in a memorial presented before the American Foundrymen's association in convention at Boston in 1902. In the year following, he elaborated the subject in a paper read before the New England Foundrymen's association, in which he again urged foundrymen to take some action in view of the growing difficulties experienced with pig irons of otherwise good composition. If an investigation of this subject was desirable then, certainly it is necessary now. Post-war exigencies compel furnacemen to cheapen production costs in every direction to remain active. Constant cry for more tonnage from the furnaces has led to the practice of surcharging the burden with high percentages of scrap bought as cheaply as possible. Many furnaces today have become huge cupolas for remelting and desulphurizing cast iron scrap, while still reducing almost as much ore as heretofore in the regular way. Scrap additions have enabled the blast furnace to effect a saving in coke of 30 per cent and a tonnage increase of 60 per cent. The foundryman has every reason to become worried.

While nothing came of the appeal made by the writer years ago, nevertheless occasionally the technical press recorded cases where foundrymen had difficulties in getting castings free from blow-holes and gas phenomena, only to get out of trouble when one or more of the brands of pig iron used were changed. Articles written by J. E. Fletcher and Y. A. Dyer in 1921 and 1922 give some interesting facts in this connection. As things got worse the foundrymen of Germany appointed a committee to dig out data and work out a remedy. The raising of scrap prices sufficiently to make its use unprofitable relieved this committee of its work at the time. The American Foundrymen's association has the question up also and is planning work co-operatively with the furnace interests, and it is to be hoped that something tangible may be worked out in the not too distant future.

In the meantime, there is no immediate prospect of a solution before the foundry industry. The use of large quantities of scrap in the blast furnace will persist no matter what is urged against it, so long as there is a dollar to be made and a market still to be had. Individual large foundry interests consequently are beginning to take cognizance of the situation and are planning to contract with satisfactory sources for all ore pig irons at special prices covering profit losses through tonnage reduction during the life of the order. However, after all, this will amount to giving a better price for a higher grade pig iron, just as charcoal pig iron commands a premium over the ordinary coke irons. As necessity causes this discrimination against the ordinary run of pig iron of today for foundry purposes to spread, it will be part of wisdom for both foundry and furnace interests to co-

FOR the benefit of any who might think the subject is new the author first discusses the early history of an agitation for some standard method of evaluating the quality of pig iron in addition to the usual chemical analysis. The need is stated to be caused largely by the practice of blast furnace operators in using cast iron or steel scrap as part of the furnace burden. Some foundry interests are said to be planning to contract for all ore iron at special prices to insure receipt of the desired quality of pig iron. Factors for improving the quality of iron in the castings by such methods as superheating also are discussed.

Dr. Richard Moldenke retained as a consultant by several important interests, has had a long and distinguished career in connection with the foundry industry. He was one of the founders of the American Foundrymen's association in 1896 and was the second secretary of the organization, holding the position continuously from 1900 to 1914. Since that time he has acted on various important committees and at the Syracuse convention in 1925 he was presented with the Joseph S. Seaman medal in recognition of his many contributions to the foundry industry.

He has been a most prolific writer on metallurgical and general foundry subjects, including his basic text book Principles of Iron Founding, and a companion volume on the manufacture of malleable iron castings. Through his connection with the International and the American Society for Testing Materials he has devoted considerable time to a solution of the problem of an international test bar for gray iron.

ordinate these tendencies and bring them into line with the smallest possible market disturbance. This will mean a standard method of evaluating foundry pig irons, as based upon quality.

Just what such a standard method will be when fully developed is hard to say. The foundryman of today tests out a car-load of some new iron by getting as much of it into his mixture as possible, repeating until he is satisfied that the sprues he recharges have acquired the characteristics of the new iron, and then makes comparative physical tests with the new as against his old brand records. Upon the results thus obtained the new iron either is rejected or added to the list of eligible brands for the class of castings to be made. This is a crude, even if practical way of dealing with the situation and may work hardship to the furnace or cut out an opportunity for the foundry for good service if the test results are close to the line and the tests are not carried out by fully competent men.

Too many elements of uncertainty enter into the operating details and some little thing may turn the results one way or the other.

For example; With a close supervision of the coke and iron ratio for cupola charging, a marked variation in the size of the pieces of coke from one day to the next will make a difference in the temperature of the iron tapped out. With dull iron, especially if carried a long distance and poured into a number of molds from one ladle, the loss of castings is bound to be higher than if a greater liberality with the coke had given fine hot iron with a good life. The poor results thus obtained might condemn a new pig iron, whereas the melting practice was to blame. A standard method of testing pig iron for its quality would have to be a laboratory operation and under circumstances which permit reducing the number of variables entering into the problem to the smallest number possible and have these under reasonably accurate check control.

Extra Items

Change from fracture grading to chemical control in the merchandising of pig iron, while bitterly fought in the beginning, proved a blessing to the furnaces in the end, for it led to greater uniformity in product, a surer production of the compositions desired, cutting off the great bulk of complaints by foundrymen, segregation of those foundrymen who might be termed hopeless for using irons by analysis, and the opening of the world as a market for pig irons of all countries so long as the analyses were guaranteed.

That this blessing has proved to be not an entirely unmixed one, must be laid to the fact that our present analytical methods do not give the full analysis of the iron. Were it possible at this day to add a few items to the list of the usual determinations, so that dissolved iron oxide, nitrogen, possibly hydrogen, the actual combinations existing on the part of the contained sulphur and phosphorus, an entirely different picture of the value of a pig iron might be had. This question, though recognized and worked upon, is not likely to be settled in the near future, and hence something of more immediate value in the way of a solution is required.

Perhaps no developments of interest to the gray iron foundry brought out in recent times have such potent possibilities as the extreme superheating of cast iron and the synthetic production of that material from steel scrap. These features were presented last year in a paper read before the Detroit convention of the American Foundrymen's association by Prof. Piwowarsky.

Deoxidation Takes Place

Apart from his interesting theory of graphite nuclei in molten iron of ordinary superheat being responsible for a lower physical strength, and the removal of these nuclei through intense superheating giving a much better and stronger material, the one point he did not bring out specifically is that under the extremely high temperature prevailing in a bath of the molten metal as he wants it, there is every chance for a thorough deoxidation by the reaction between the carbon present with any iron oxide that might be in solution.

Consequently, if this reasoning of the writer be true, there is a chance to correct the irons made under bad blast furnace practice, the difficulties resulting from excessive scrap percentages in the foundry mixture, and any poor melting practice previous to the additional intensive superheating; and then to obtain a high grade molten iron for pouring off the molds in spite of poor quality pig irons. This procedure involves additional expense in melting and makes the metal in the ladle more costly. It is better practice to start with good material in the first place than later to correct that which is admittedly poor. This does not solve the question of differentiating between the all ore operating furnace and the one which remelts large percentages of scrap. Surely the careful and conscientious furnaceman is entitled to the best market price and the maker of low quality metal should be penalized.

High Grade Pig

While the indications are that the foundryman can overcome the handicap of poor foundry pig irons by this new method of intense superheating, and further, so long as the price of scrap permits it, furnaces will—more or less—continue the practice of using it; the foundryman will find himself between the alternatives of paying extra money for getting good castings by way of intensely superheating, only paying extra when making certain of getting high grade foundry pig irons. Between these two alternatives he will choose the well-made pig iron every time, for he can then still add the high superheat if the quality of work requires it.

No matter how the question is turned and considered it comes back to working out a standard method of testing pig iron for its quality. This may be by melting test pieces of the pig iron in an electric resistance furnace, under pyrometer control, so that no higher superheat is attained than that required for a standard pouring temperature. Then making test bars and testing them for comparison with similar tests with the bars from other known brands of pig iron for that particular foundry. This naturally involves the effect of the chemical composition upon the physical properties brought out by the tests.

In such a method, with the standardization of the degree of superheat attained, a standard pouring temperature; with standard test bars and molds in which they are made, standard physical tests and analytical results, there remain practically only the gathering of data and their study to interpret such test results into quality measures of foundry pig iron. This is no small work and would engage the attention of foundry and furnace metallurgists and engineers a long time. Possibly some other, better way can be suggested to replace the present cut-and-try method by way of the cupola, but that something must be done about the situation, and that without great delay, is patent to every close observer of the trend of blast furnace practice so far as the production of foundry pig irons is concerned.

States Scrap Is Not Detrimental

Analyses From Furnaces and That of Buyer Agree—Insistance on Correct Specifications Should Guarantee Quality

By David McLain

AFTER buying pig iron on exacting chemical specifications over a period of more than 25 years I have had reason on only comparatively few occasions to file even minor complaints of a discrepancy between our analysis and that furnished with the shipment. On a personal basis I have no objection to the use of scrap iron as part of the blast furnace burden. A vast amount of gray iron scrap now upon the market and viewed with suspicion by foundrymen possibly might be purified if it was run through the blast furnace with the proper kind of ore.

Gray iron scrap has been used extensively for many years by operators here and abroad in making pig iron. My personal preference if foreign additions are necessary, is plain carbon steel scrap. It is the purest metal charged either into the cupola or blast furnace. It is low in phosphorus and and produces the strongest iron.

Ores containing a medium phosphorus content and which produce pig iron with phosphorus from 0.50 to 0.60 per cent, will produce a still lower phosphorus pig if it is reduced in connection with steel scrap. The amount of phosphorus reduction will be in direct proportion to the percentage of steel scrap in the charge.

Common practice in gray iron foundries favor the use of as much steel as possible in the cupola charge where strong castings are required and where all the available pig in the yard is high in phosphorus. A 50-50 mixture of steel scrap and pig iron in which the steel has a phosphorus content of 0.05 and the pig iron shows 1.00 per cent of the same element, will produce a casting with a phosphorus content of 0.50, an ideal content for many classes of light castings.

As an item of fairly common knowledge steel scrap has been used by certain blast furnace operators since 1911 or 1912 to make low phosphorus iron for ingot molds.

The mere fact that scrap is charged into the blast furnace is not responsible for the dissatisfaction with foundry irons which seem to underlie the present discussion. That scrap, good in itself, exerts a deleterious effect on the metal tapped from a blast furnace is open to question. The foundryman is not concerned with what goes into the blast furnace. His interest lies altogether with the material that emerges. He wants something with certain chemical and physical properties that will make satisfactory castings.

Many men who hold to the opinion that scrap additions to the blast furnace burden are injurious, claim that chemical analysis will not tell the complete story. That also is my opinion where by chemical analysis reference is made to the almost universal practice of absolute dependence upon the precentages of carbon, silicon, sulphur, manganese in the pig iron. Microscopic study of a metal often is the second step taken where a pig iron of apparently correct analysis fails in a casting. The conditions found in the casting in some cases are ascribed to faults in the ore or the scrap charged into the blast furnace which produced the pig iron.

Instead of confining himself to a microscopic study of the metal which failed in the casting, should the chemist not dig deeper into the mysteries of pig iron from which the casting was made?

More than 100 years ago chemists discovered that pig iron is an exceed-

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IN THIS paper contributed to the conference on qualities of pig iron held at the recent Chicago convention of the American Foundrymen's association, David McLain claims that the addition of gray-iron scrap to the blast furnace burden is not a factor to cause uneasiness in the minds of foundrymen. Personally, if scrap is to be used, he prefers steel scrap since it is a much purer metal than any form of cast iron and exerts a purifying influence on any ferrous mixture in which it is incorporated. Sulphur and phosphorus content automatically are lowered with a resulting increase in desirable physical properties. Iron as metallic iron composes only about 60 per cent of gray iron, the rest of it being combined with other elements.

David McLain originator and active head of McLain's System, Milwaukee,

has been connected with the foundry industry for a period of over 50 years. As an advocate of the use of steel in gray-iron mixtures and as a teacher of the process he is known not only to every foundryman in this country, but to a wide circle of prominent foundrymen all over the world. He is a native of Pittsburgh where he entered a foundry at the tender age of 10 and where he had progressed to the position of foundry foreman in a crucible steel shop by the time he was 21. About 25 years ago he relinquished the position of superintendent in a prominent foundry in the Middle West to start the correspondence school with which his name since has been associated. In addition to supervising the affairs of the school he carries on an extensive consulting practice.

ingly complicated mixture. In 1830 Karsten issued a French edition of his *Metallury*. In addition to the usual elements carbon, silicon, phosphorus, sulphur and manganese he also found calcium, magnesium and chromium. He claims that even the purest pig iron is quite a complex compound. Presence of so great a number of foreign elements, renders a complete analysis of pig iron one of the most complicated operations in the field of inorganic chemistry.

On page 235 *Archives de Karsten*, Vol. XXV, 1853, reference is made to two analyses which suffice to show the complicated composition of pig iron. The irons were made from tertiary limonites, smelted with charcoal in a hot blast furnace. The analyses follow:

Total carbon	2.876	2.215
Silicon	2.748	1.981
Sulphur	0.207	0.083
Arsenic	0.139	Trace
Phosphorus	0.421	0.058
Calcium	0.352	0.352
Magnesium	0.146	0.895
Aluminum	0.032	0.272
Molybdenum	0.184	0.014
Chromium	0.080	0.051
Vanadium	0.004	Trace
Manganese	8.953	2.814
Metallic iron	83.383	90.718
Specific gravity	6.668	5.799

Traces of nitrogen, antimony, sodium, lithium, potassium, titanium, copper, cobalt, and nickel intermingled with iron have been found in spiegeleisen from Miisen.

Complex Proposition

A few years ago in a public lecture one of America's best known chemists and metallurgists stated: "Silicon, sulphur, manganese, phosphorus and part of the carbon are not present as such in the iron. The silicon will alloy with about three times its weight of iron to form silicide of iron, the phosphorus with about six times its weight of iron to form a phosphide of iron, the combined carbon with a still larger amount of iron to form a carbide, while the sulphur and manganese will form manganese sulphide if present in proper proportions. It is a serious mistake to assume that if you sum up the percentages of the elements furnised by the chemist and subtract the total from 100, the remainder will represent the metallic iron content. Also the structural arrangement plays an important part. You are dealing with a complex proposition in any consideration of the internal make up of a gray iron casting, both from a chemical and a structural point of view.

"While these particular facts in no sense are new, they are presented now with the thought that the more intimate the foundryman becomes in these particular features, the more interested he will become in his special problems.

"The foregoing has been presented to show that a chemical analysis alone may yield but scant information under certain conditions. Let us see how it works out in the case of gray iron of the following composition: Silicon 2.50 per cent; phosphorus 0.70 per cent; sulphur 0.08 per cent; manganese 0.14 per cent; combined carbon 0.25 per cent; graphitic carbon 2.25 per cent; total 5.92 per cent.

"The 2.50 per cent silicon will produce 7.39 per cent silicide of iron. In like manner the phosphorus, sulphur, manganese and combined carbon respectively will produce 4.47 per cent phosphide of iron; 0.22 per cent manganese sulphide; 28.13 per cent pearlite and 2.25 per cent carbide. The graphitic carbon goes through no change.

"Sum of the elements according to the first calculation amounts to 5.92 per cent, from which it would appear that the metallic iron should be 94.08 per cent. Totaling the alloys resulting from the union of these elements with the amount of iron with which they combine, plus the graphite, the sum is 42.46 per cent. The amount of iron actually existing as iron in the casting is only 57.54 per cent.

To summarize: Scrap metal is charged in blast furnace. This in itself is not conclusive evidence that the metal tapped from the furnace is unfit for pouring castings. Foundrymen should know what analysis in the pig iron meets their requirements. Insistence on correct specifications being met in this respect should furnish sufficent guarantee of the quality of the iron.

Book Review

Feuerfeste Baustoffe fur Kammern der Kokerei-und Gaswerksofen, by L. Litinsky, 50 pages, paper, 6¼ x 9¼ inches, published by W. Knapp, Halle (Salle) Germany, and supplied by THE FOUNDRY, Cleveland, for $1.00 and in London, 2-3 Caxton House, Westminster, for 5s.

This work which is published in German relates to refractory materials for the chambers of coking and gas-making ovens. The first chapter gives a general classification of refractory materials. The second covers the type of refractory demanded for the chambers of coal distillation ovens. Chapter III gives some remarks on raw materials for refractories. Properties desired in refractories for coke ovens are related in Chapter IV, followed by a chapter on wall repair and one on silica brick and firebrick as oven wall materials.

Book Review

Non-technical Chats on Iron and Steel, by LaVerne W. Spring, 465 pages, 5½ x 8 inches, cloth, published by Frederick A. Stokes Co., New York, and supplied by THE FOUNDRY, Cleveland, for $4.00, and in London, 2-3 Caxton House, Westminster, for 20s.

A study of the metallurgy of iron, our most useful metal, should prove interesting to anyone. One difficulty met by the general reader is that the technical terms and descriptions are not readily comprehended unless he is familiar with the subject. However, in this book the author has endeavored to explain the metallurgy of iron and steel in every-day, easily-understandable language, and he has succeeded remarkably well. The reader is initiated into the early history of iron and then is carried to the mines to see the ore produced. From this stage he is shown the manufacture of pig iron in the blast furnace and then follows the manufacture of steel, wrought iron, cast iron, malleable iron, cast steel, alloy steels, etc. The methods of rolling and drawing steel into the various products of commerce are revealed and in the closing chapters the reader is shown how physical and chemical properties of the materials are obtained and their value. A bibliography of references relating to each chapter is included at the end of the book.

Becomes District Manager

William B. Senseman has been appointed Pacific coast district manager for the Combustion Engineering Corp., Raymond Bros. Impact Pulverizer Co., Ladd Water Tube Boiler Co., and the Heine Boiler Co., all subsidiaries of the International Combustion Engineering Corp., New York. Mr. Senseman has been associated with the Raymond company for the past 15 years and since 1917 has represented that firm on the Pacific coast. The consolidated office is located in the Subway Terminal building, Los Angeles, Calif.

The Triangle Foundry Co., East Alton, Ill., which recently was organized is now open for business. The foundry is located at Haynes avenue and the C. & A. railroad. D. D. Hughey and M. B. Dewey head the firm.

Maytag Co. Erects New Foundry

Fig. 1—Ample Stock Yard Facilities, Served by Cranes, Provides for Storage

¶ By Henry M. Lane

BUILDS *Continuous* SHOP

Iowa Washing Machine and Implement Firm Provides Production Machinery for Its Gray Iron Casting Needs

F. L. MAYTAG, Newton, Iowa, has been interested in the agricultural implement business and the manufacture of agricultural implements for many years. More recently, he became interested in the development of a washing machine and in co-operation with an inventor by the name of Snyder they brought out a machine which they started to manufacture in rather a small way.

Mr. Maytag decided on a method of sales which was new in the washing machine business. His agents take a machine to a house and offer to do washing free of charge and then leave the machine for the lady to try out next week. The result has been that most of the machines stayed put and the sales went up by leaps and bounds topping 800, 1000, 1200 and this year the program is for 1600 washing machines a day.

From the foundry standpoint making a washing machine divides itself into two parts. First, it is the production of the tub with its essential integral parts of the dolly, the crown, and the cover and all of these are made of aluminum and their manufacture was described in THE FOUNDRY for July 15, 1925. The iron parts are smaller but numerous, and such parts as the wringer and the legs are light and thin and must have as good a finish or surface as any stove-plate castings. In addition, a number of small gears and other parts stack up a requirement of between 25,000 and 30,000 molds per day.

The company's business has grown and little by little the territory surrounded by a certain group of streets has been utilized until only one piece was still available and this laid between the old foundry and the new machine shop. A new foundry recently has been built occupying this position. The old foundry is on the one side and the new 6-story machine

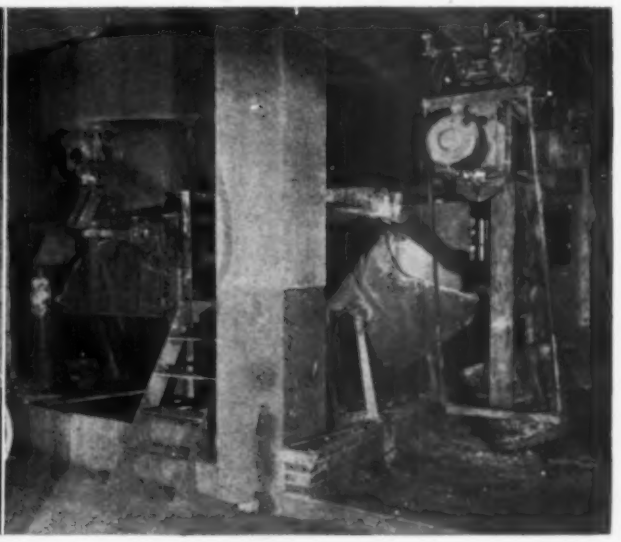


Fig. 2—Materials Are Brought to the Charging Floor in Drop Bottom Buckets and Charged Directly Into the Cupolas. Fig. 3—Iron is Tapped Continuously Into Receiving Ladles and Poured by Hand

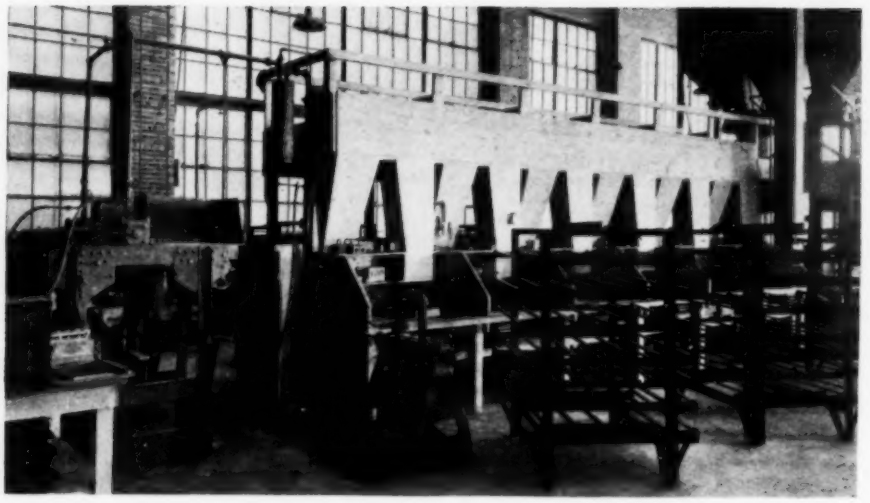


Fig. 4—Core Sand Is Delivered Directly to the Core Makers Benches

shop on the other. To get the desired production of castings in the relatively small ground area available, it was necessary first to construct a multiple story foundry and second, to go to continuous melting and mechanical handling. Hence, the layout of the plant became a matter of designing a machine to produce the Maytag's castings requirements in gray iron. The following description shows how the various parts of this machine were made to function.

The street door on one side is used for the removal of refuse and the castings pass out of the foundry at the further end directly into the machine shop. The first floor is used for cleaning and grinding castings and the second for production.

Delivering the raw material into the plant was complicated in the Maytag installation by the fact that the railroad which enters the center of the property comes to a dead end against the machine shop building at the end of the foundry.

The small amount of yard space available was spanned by a 75-foot crane made by the Shepard Electric Crane & Hoist Co., Montour Falls, N. Y. as shown in Fig. 1. This crane is of special design having a double hoist trolley with operator's cage fixed on one end of the trolley. The two hoists each control a 66-inch magnet and operate independently.

In the left foreground of Fig. 1 may be seen the charging floor which consists of a series of bins surrounded by timber bulkheads. In practice about 90 per cent of the incoming melting stock is taken directly from the cars to the charging platform by the magnets. The temporary wooden buildings in the center of the yard are being removed to make room for storage. The concrete structure beneath the charging platform consists of a series of deep bins or silos and is used for the storage of molding sand, core sand, and fire clay. These products are unloaded into a hopper beyond the box car shown standing on the track and a conveyor system takes the material toward the foundry building. The sand passes up an elevator under the charging floor and is plowed off into the various bins along the side of the building. Any overflow which the plows fail to remove from the belt passes down the tailings spout shown at the near end of the bins and is discharged into the small tailing bin which is emptied as each ship-

Fig. 5—The Production Floor Is Divided into a Number of Units, Each Centering on a Conveyor System

Fig. 6—A Pouring Platform Is Provided Between Adjacent Molding Stations and Iron is Poured to Either Side

ment is put into one of the storage bins.

Coke is taken in through the same system and is carried by suitable belts across over the charging floor and lands in a 1000-ton, coke bin on the charging floor level.

The charges are made up on the charging platform with the use of conical-bottom charging buckets handled by the charging crane, all made by the Chisholm-Moore Mfg. Co., Cleveland, as shown in Fig. 2. In this view the two cupolas are shown at the left and one of the two charging machines at the background. The deep buckets shown are used for standard charges while the shallow buckets are used for bringing sprue back from the sorting platform in the cleaning room. This sprue is brought back hot and normally is recharged into the cupola not more than 90 minutes from the time it flowed from the spout. This is a big saving in the matter of storage and handling of the sprue and in this plant every cubic foot must be made to do its share in turning out the product.

The deep charging buckets are taken out on the stock platform on the three-wheeled buggies, filled, run on the scales and weighed. The coke is put in first, then the pig iron, and last the foreign scrap. The charges consist either of one large bucket of the general charging material and one small bucket of sprue or at times the coke is charged separately in one of the small buckets. In the latter case three operations are required in putting in the charge.

Beyond the last cupola is a steel lined shaft extending through the foundry space to the cleaning room through which the buckets of sprue are lifted back to the charging platform by the charging machine.

They are then set down and run on the scales and brought to the proper balance by addition or removal of scrap.

Overhead in Fig. 2 can be seen the conveyor system which handles coke from the head of the coke elevator in the background to the 1000-ton, coke-storage bin at the end of the platform from which the photograph is taken.

The cupolas, two in number, of the continuous type, built by the Whiting Corp., Harvey, Ill. stand on the foundry floor level. At the stock

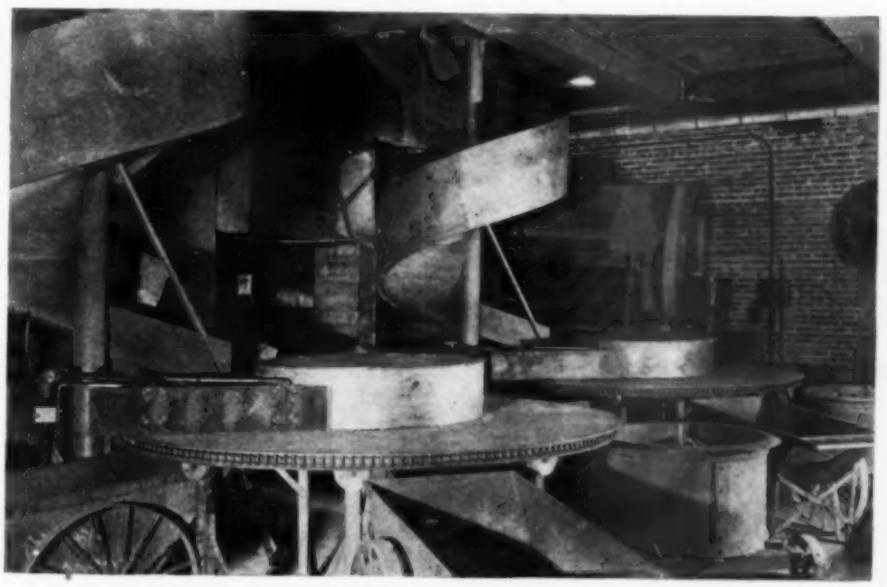


Fig. 7—Castings Are Delivered to Sorting Tables by Spiral Conveyors, Where the Castings Are Relayed to the Cleaning Department and the Sprue Returned Directly to the Cupolas

yard end of the foundry a section of the building approximately 30 feet wide contains all of the features not entering directly into the production of castings such as the melting, the blower rooms, the stock room, washrooms, toilet rooms, locker rooms, core ovens, etc. This section of the building is 5 stories high, with a mezzanine floor between the ground floor and the foundry floor proper and another between the foundry floor and the charging floor. The blower room is located between the two cupola on the second mezzanine. The blower equipment consists of two positive pressure blowers direct connected to General Electric Co. variable speed, alternating current motors. These motors were selected on account of the fact that it is possible to give a wide range of speeds with almost imperceptible differences in the variation and in a continuous melt this makes it possible to trade pounds of air for pounds of iron in the cupola.

For the control of the cupolas an instrument was installed which gives a visible reading and record of both pressure and volume at all times. This was made by the Bacharach Industrial Instrument Co., Pittsburgh.

Immediately over each spout on the mezzanine floor an optical pyrometer is mounted and as the room in which these instruments are mounted is lighted by artificial light a true reading results.

The metal flows from the spout of the cupola continuously into a receiving ladle and these receiving ladles are tilted by an electrical gear.

Each cupola has two tapping holes, one above the other, and the lower one is kept continuously open. The upper one is used as a control and is opened only when the behavior of the cupola shows that the iron is approaching the slag hole. The slag passes down an inclined spout which may be seen under the cupola in Fig. 3 and falls through a tube or casing from the foundry floor through the first mezzanine floor into a rubbish room on the first floor. The cupola drop also falls through this same opening.

The metal is distributed to the molders by three cranes, one of which is seen at the cupola in Fig. 3. These cranes were made by the Sprague hoist division of the General Electric Co., Schenectady, but since they were made the Shepard Electric Crane & Hoist Co. has taken over the Sprague business including the ladle cranes.

The coreroom is located at the end of the plant adjacent to the machine shop and the general view of this department is shown in Fig. 4. The various grades of sand necessary are mixed in a mill made by the National Engineering Co., Chicago, located to the right of the core benches as shown and the material discharged from this mill passes up an elevator into the three overhead metal sand bins. From these the various grades of sand are wheeled out and dumped into the bins over the core benches. Since this illustration was taken the sand delivery has been extended over the core machines shown at the right, which were made by William Demmler & Brothers Kewanee, Ill. The cores are put on the racks shown and handled by a lift truck to a battery of three forced-draft, auxiliary-air, coreovens located in the service section of the building. These ovens made by Holcroft & Co., Detroit are fired with breeze coke, the firing room being partitioned off from one of the locker rooms on the first mezzanine floor and the coke coming to the firing room through a tube from the 1000-ton, coke bin in connection with the charging platform. The breeze coke which passes through the forks in making up the charges is used for firing the ovens. Behind the coreroom is a small jobbing floor for making miscellaneous castings.

The foundry production unit proper consists of 12 drag type mold tables, each served by six molders. The molders work on opposite sides of the shovelout bins as shown in Fig. 5. The molds are placed on the table conveyor as it passes the molders and in most cases the men also receive their flasks from the carrier. Between each set of sand bins is a core delivery alley and this alley also serves for the convenience of the men who change patterns and serve the molders in other ways.

Fig. 5 also shows several interesting features in connection with the plant. The 12 tables are arranged in two sets of 6 each with the pouring stations at the outer ends and the shakeout stations in the center of the floor. Through the center of the floor as shown in the illustration moves a depressed continuous-pan carrier and all molds are shaken out on this carrier so that both sand and castings ride down to the right as shown in Fig. 5. At the end of the carrier the castings are forked off into 4 holes leading to castings chutes that take the material to the cleaning room as described later.

In the foreground of Fig. 5 is shown a vertical metal flue extending up through the center of one of the mold tables there are four of these flues located over the castings chutes below

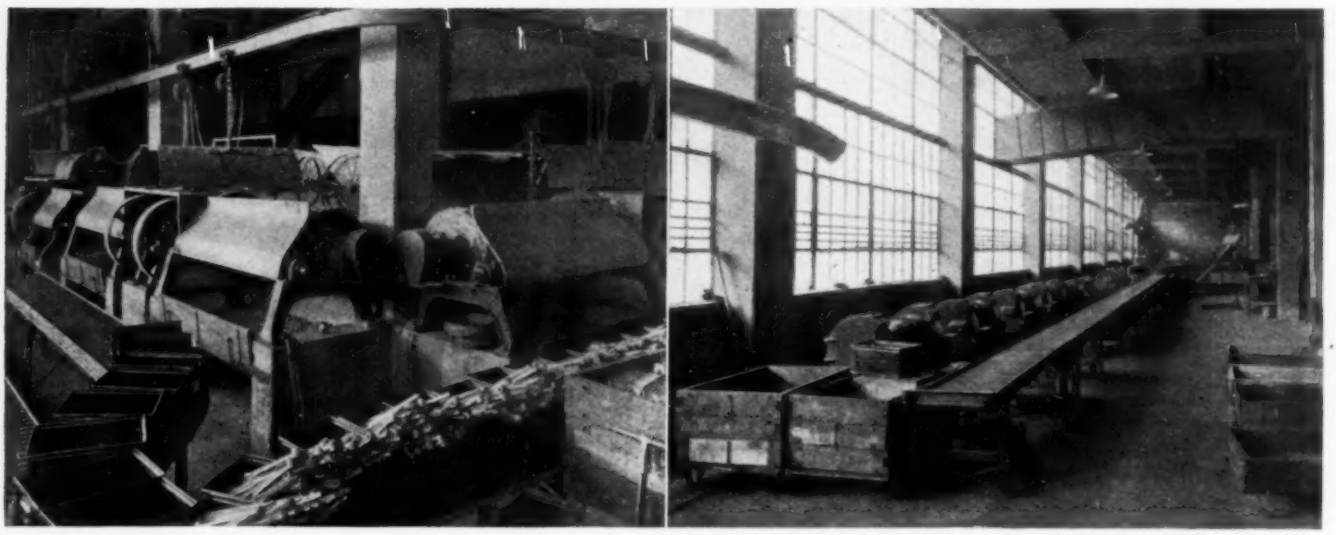


Fig. 8—Buggies Deliver the Castings Directly into the Tumbling Barrels. Fig. 9—Floor Stand Grinders Along the Well Lighted Side Are Served by Roller Conveyor Tables

and the heat from the hot castings rising makes a sharp ascending current of air. This tends to draw cooler air to the workmen in the cleaning department and at the same time to help in scavenging the air from the foundry.

Many of the molding machines used on this floor were made by the Milwaukee Foundry Equipment Co. The plant is completely equipped with these machines with the exception of a few home made stripping plate machines.

Fig. 6 shows one of the pouring stations located between two of the mold tables. These pouring stations are raised to a convenient height.

Since between 25,000 and 30,000 molds are poured per shift, it was found impractical to pour directly from ladles filled at the cupolas and hence, hand ladle pouring was decided upon as being more flexible. The section of the shop, where the heavier work is made is equipped with a small, hand-operated, monorail, pouring system.

At the left of Fig. 6 is a raised gravity carrier used for delivering some of the flasks back to the molders.

The entire first floor is devoted to the cleaning, grinding and inspection of the castings. The castings after being forked into the chutes descend spirally as shown in Fig. 7 and land on revolving sorting tables. The sprue is broken off and thrown into a charging buckets on the 3-wheeled truck and this is taken from the sorting platform to the cleaning room floor by a short hydraulic elevator and shifted to a point where the charging machine can pick it up and take it to the charging platform. A service elevator also is installed to be used in case of emergency or for handling any material between several floors of the building.

The castings are thrown into 2-wheeled carts as indicated in Fig. 7 and then are wheeled to the outside edge of the platform and dumped into tumbling barrels as shown in Fig. 8. It will be noted that the tumbling barrels are mounted so that their tops are approximately flush with the sorting platform. Two batteries of dust arresters, are provided, one serving the tumbling barrels and the other the grinders.

The tumbling barrels are driven individually from electric motors mounted in a tunnel which runs around to the edge of the sorting platform and this drive makes possible inching the barrels around to place them in any desired position. The barrel doors are handled by chain hoists which are attached to the monorail track.

The product from the barrels is dumped upon sorting tables which may be seen below the barrels and the front of each table is arranged so that it can be dropped down as a working shelf during the sorting operation. The castings are handled away from the barrels in tote boxes which take them directly to the grinding operations.

The grinding machines are arranged in a continuous row along one side of the plant as shown in Fig. 9. This disposition makes it possible to carry the exhaust through a tunnel behind the machines, to deliver the work to the workmen on gravity carrier and to carry away the finished product in the same manner.

The grinding operations are divided into various sections and each class of castings is finished completely and polished in the section in which it is operated upon. In this connection many grinding and polishing operations formerly performed in the machine shop have been placed in this department. This makes possible the delivery to the machine shop of completely finished castings so far as the grinding and polishing are concerned, and has resulted in a big saving in operations.

The remainder of the first floor is taken up with the dust arresters unit, sand blast barrels, shipping and control office, and castings storage.

All equipment for bringing sand and coke into storage, for handling and tempering the molding sand, and handling molds and castings was installed by the R. W. McIlvaine Co., Chicago. The tumbling barrels, dust arresters and one sand blast barrel were made by the W. W. Sly Co., Cleveland. The other sand blast barrel was provided by the New Haven Sand Blast Co., New Haven, Conn.

The order for grinding equipment was divided between the U. S. Electric Tool Co., Cincinnati and the Black and Decker Co., Baltimore.

This continuous foundry has made possible the production of approximately twice the number of molds per day per molding machine, has reduced the scrap by more uniformly tempered sand and sand in better condition in every way, and at the same time the overhead expense for the number of flasks necessary for a given production is greatly reduced.

The old gray iron foundry now is utilized as a cleaning and finishing department for aluminum castings.

The H. M. Lane Co., Detroit, provided the general design and supervised the equipment. The architectural work on this and other buildings for the Maytag Co. was carried out by Henry Raeder, Chicago.

Book Review

Tool Control, by Anker L. Christensen, 134 pages, cloth, 5¾ x 8½ inches, published by the Ronald Press Co., New York, and supplied by THE FOUNDRY, Cleveland, for $3.50, and in London, 2-3 Caxton House, Westminster, for 15s 6d.

An adequate tool system is necessary in any plant where machining operations are carried on. An efficient tool system should give service which means the right tool in proper condition, delivered to a certain place at the right time. The author describes a system installed in one of the large manufacturing plants to meet the previously mentioned qualifications. The various steps in establishing a tool control system are covered. These include preliminary analysis, tool classification systems, tool cribs, methods of issuing tools, inspection, allocation of costs, executive control, tool crib personnel and tool development. Any individual or firm contemplating the establishment of, or making changes in the present tool control system will find that a study of this volume will repay the time spent.

Open New Foundry

The new foundry of the Koken Co., St. Louis, manufacturer of barber shop equipment now is melting 10 tons per day. About 47 men are employed and within the next month or two, the force will be increased. The firm has been in existence for 50 years, but only recently has been making its own castings. Officers of the firm are W. F. Koken, president; G. D. Chisholm, vice president; E. W. Meier, vice president and secretary; W. L. McKim, vice president; W. S. Jencks, treasurer. F. J. Stretch is general superintendent of the plant.

Describes Processes

The Federal Abrasive Co., Anniston, Ala., recently has published a 28-page booklet describing the methods of manufacturing aluminum carbide and silicon carbide employed in its plant. The booklet is well-illustrated with reproductions of the electric furnaces which produce the products and the various grinding and sorting machines. The features of the abrasives manufactured by the firm are given as are the physical and chemical properties of the material.

How and Why in Brass Founding

By Charles Vickers

Desires Pattern Metal

We would like to know how to harden white metals in order to be able to make patterns that are not too soft.

An alloy of little shrinkage frequently used for white metal patterns consists of half zinc and half tin. This alloy is usually hard enough for the purpose to which it is put, but it is an expensive alloy. It has one advantage and that is the patterns when no longer needed, may be used to make brass. Ten pounds of this mixture with 5 pounds of lead and 85 pounds of copper make the well known ounce metal.

If the white metal has a lead base, the proper metal to harden it is antimony. A good pattern alloy of this kind is lead, 80 per cent; tin, 10 per cent; antimony, 10 per cent. If this alloy is too soft for the service intended, simply increase the antimony and decrease the lead by the same amount. The tin will confer fluidity and soundness. Without tin, alloys of lead and antimony run *mushy* in sand molds, similar to alloy of copper and aluminum. Bubbles form which when pricked leave holes. Such alloys though have the disadvantage that they cannot be used in making brass because of their antimony content. Patterns also are heavy, so considering all things zinc-tin alloy while more expensive has many features to recommend it.

Must Vent Properly

We manufacture hose couplings of various alloys and occasionally encounter difficulty due to the threads breaking out as shown by the samples sent you. The metal has to be ductile as the castings are expanded when the hose is attached to the coupling. The samples sent are of a yellow brass mixture. Can you suggest how to avoid this difficulty?

Castings are made in a manner similar to bushings with a cored interior and lying in the horizontal position. When the mold is poured the metal fills it rapidly and during that short interval the gases produced by the burning of the core have to be evacuated. Should there be any doubt about all the gas produced from the core getting to the vent almost instantly, this doubt should be removed entirely by so making the vent that it will be easy and logical for the gas to escape by this route, and not into or through the metal. One way of doing this is to make the core almost a shell, another way is to put a ring of smaller holes through the core at a short distance from the surface to be covered by the metal, and connect these vents with the central vent. It will be necessary to have patterns with core prints accurately round, and cores to fit these prints exactly, for if metal gets into the vents, the result will be the same as though there were no vents. If after a study of the situation, there is no doubt in mind, that the gas should be able to escape through the core structure, instead of through the metal, it will be well to watch closely the castings as they come from the sand for a while to determine whether some have their vents filled with metal. Then take these castings and put them through finishing operations and note whether the threads break away, or not. It is likely most of them will.

The difficulty is caused by gas which lies in a thin film between the outer and inner surfaces of the metal thicknesses, and which acts exactly like the parting put between the cope and drag of a mold and causes a split during machining operations. Yellow brass and red brass alloys containing considerable zinc are peculiarly susceptible to this difficulty which leads us to imagine the possibility of the particular gas that causes it being insoluble in such brass, so that it fails to diffuse into the metal, and produce the condition known as porosity.

An immense amount of gas comes from a mold when yellow brass is poured into it. To facilitate the escape of which, it is always advisable to cut channels down the length of the cope after it is closed, and over the highest point of the castings, so that when the weight is put on the mold a way of gas escape is provided. These little precautions take time, but scrap castings fail to pay dividends.

Dip Gives Uniform Color

We would like to know what we can use to produce a uniform color on our brass castings after the necessary machining and filing has been done. Such work, of course, leaves bright and dull portions and what we want is a uniform color. Can you tell us how to produce that effect?

The only operation that we can think of is to acid dip the castings after they have been machined. A suitable dipping acid consists of sulphuric acid 2 gallons; nitric acid 1 gallon; salt 2 ounces. It will be essential first to clean the castings of all grease, otherwise the dip will not work, and after being dipped the castings must be washed thoroughly. Finally washed in hot water and then dried in hot sawdust.

If there is much dipping to be done it will be advisable to engage the services of a good plater; one conversant with the dipping of metals. It is not to be expected that anyone unfamiliar with the work could carry it on satisfactorily, as the dipping and cleaning of brass, and the preservation of the dipped colors is a highly specialized trade.

Wants Type Metal Alloy

We would like to obtain a formula for a type metal having a fusion point of 775 degrees Fahr., which will not contain zinc. This metal is to be used in a type casting machine.

Type metal is used over and over again. After the type have served their purpose they are sent to a "remelter" where they are melted and run into ingots, which then go to the linotype machines. This has a tendency to level all formulas, and the mixture will approximate lead 85 per cent; antimony 11 per cent, and tin 3.5 per cent, with a constant tendency of the tin to oxidize out of the mixture. Type metal never contains zinc, otherwise it cannot be used as zinc causes drossing and other troubles in casting the type. The melting point is considerable under 772 degrees Fahr., and we are unable to suggest any alloy that can be used commercially for casting type that has a melting point as high as that.

Refractories Institute Elects Officers

Officers of the American Refractories institute for the ensuing year were elected at the annual meeting held at Atlantic City, May 18 and 19, as follows: President, J. M. McKinley, Crescent Refractories Co., Curwensville, Pa.; vice president, Burrows Sloan, General Refractories Co., Philadelphia; second vice president, R. M. Sievers, Evans & Howard Fire Brick Co., St. Louis; treasurer, C. C. Edmunds, McLain Fire Brick Co., Pittsburgh; and secretary, Dorothy A. Texter, 2202 Oliver building, Pittsburgh. All of these are re-elections with the exception of the second vice president.

Eight new directors were chosen at this gathering as follows: J. M. McKinley, C. C. Edmunds, J. H. Cavender, Dover Fire Brick Co., Cleveland; E. M. Weinfurtner, Ashland Fire Brick Co., Ashland, Ky.; Charles S. Reed, Chicago Retort & Fire Brick Co., Chicago; E. A. McKelvy, General Refractories Co., Philadelphia; R. M. Sievers; D. A. Benson, Big Savage Fire Brick Co., Frostburg, Md.

The following directors were carried over for another year; George A. Balz, Seaboard Refractories Co., Perth Amboy, N. J.; J. D. Ramsay, Elk Fire Brick Co., St. Marys, Pa.; J. E. Lewis, Harbison-Walker Refractories Co., Pittsburgh; Burrows Sloan; A. P. Taylor, Chas. Taylor Sons Co., Cincinnati; A. P. Green, A. P. Green Fire Brick Co., Mexico, Mo.; H. L. Tredennick, Haws Refractories Co., Johnstown, Pa.; T. N. Kurtz, United States Refractories Corp., Pittsburgh; F. R. Valentine, M. D. Valentine & Bro. Co., Woodbridge, N. J.; George H. Diack, Queens Run Refractories Co., Lock Haven, Pa.; P. S. Kier, Kier Fire Brick Co., Pittsburgh; R. A. B. Walsh, Walsh Fire Clay Products Co., St. Louis; E. F. Myers, Ironton Fire Brick Co., Ironton, O.; W. S. Stapler, Stevens, Inc., Stevens Pottery, Ga.; and J. T. Roberts, Stockton Fire Brick Co., San Francisco.

Re-elect Officers

At the annual meeting of the stockholders of the Metals Coating Co. of America held in Philadelphia, the following officers were elected: Richard L. Binder, president; Rudolph Schroeder, vice president; George Ruck, vice president; E. W. Wilson, treasurer, and J. C. Merkel, secretary. Mr. Schroeder also is European representative of the firm with headquarters in Hamburg, Germany.

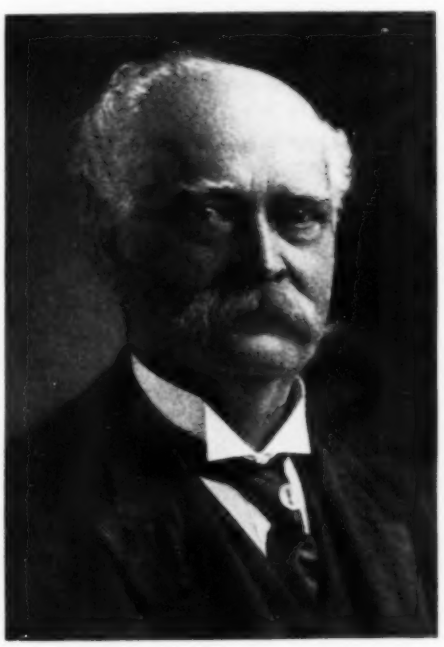
C. O. Bartlett & Snow Co., Cleveland, has opened a sales office at 406 Bessemer building, Pittsburgh. W. C. Schade has been appointed manager of this office.

Founder of Alloy Company Is Dead

FRANCIS J. CLAMER, founder of the Ajax Metal Co., Philadelphia, died at his home in Collegeville, Pa., on May 18 at the age of 86 years. Mr. Clamer was born in Hamburg, Germany July 4, 1841 and resided there until the age of 11 years. He received the early portion of his education in that city and in 1852 came to the United States with his mother to join his father in Philadelphia.

He continued his education first in Philadelphia and later in Camden, N. J., specializing in chemistry and natural sciences. Subsequently, under the tuition of his father , Mr. Clamer acquired a thorough knowledge of the trades of gold and silversmith. Later, for 5 years he engaged in the hardware, merchandise and house furnishing business and then turned his attention to the manufacture of bronze hardware.

Mr. Clamer was one of the first investigators to recognize the value of lead as an addition to the copper-tin alloys used for bearings and originated the well-known 80-10-10 bearing metal. During the early days when this alloy was being introduced, considerable discussion ensued, and many claimed that the new metal was a fraud in that lead debased the high grade and long used, copper-tin alloys. However, Mr. Clamer interested a number of men in his alloy who supplied a small amount of capital and this resulted first in the



FRANCIS J. CLAMER

organization of the Elkins Mfg. Co. and later the Ajax Metal Co.

All his life Mr. Clamer had resolved to retire from business at the age of 60 years, and shortly after the graduation of his son Guilliam H. Clamer now president of the Ajax company, from college in 1897 he was able to fufill his resolution. After his retirement he relinquished all activities in connection with the metal business and devoted his attention to farming and horticulture.

Mr. Clamer was active in the development of Collegeville where he had resided since 1890, and unanimously was elected the first burgess, a position which he occupied for many years. While he necessarily retired from active club life, his activities as a philanthropist were still a dominant feature in recent years.

He was formerly a director of the Norristown Trust Co., Norristown, Pa.; a director of the Collegeville National Bank, and a member of the board of trustees of Ursinus college. At the time of his death he still was a stockholder in the Ajax company and a member of the board of directors.

He is survived by one son and three daughters. His son, Guilliam H. is internationally known as a metallurgist has been a prominent factor in the work of scientific societies and is president of the Ajax Metal Co. His daughters are Mrs. G. W. Kelley, Mrs. Christian Bauer and Mrs. R. E. Miller.

Bill Explains How To Prevent Corrosion

By Pat Dwyer

MORE for the sake of starting an argument than for any other reason I asked Bill one night about two weeks ago if he was all set for the Chicago convention. As a matter of fact I knew he had made all arrangements and even at that moment had his ticket in his pocket. His work was all scheduled to run in his absence and his assistant was amply qualified to take care of the routine and to cope with anything out of the ordinary that might arise during the week.

"What do you mean, all set?" said Bill suspiciously.

That was not the kind of answer I had expected. In my innocence I had assumed that my simple question would start him off on a monolog and all I would have to do would be to sit back comfortably and let him do all the hard work. Instead of that I suddenly found myself on the defensive. A shabby kind of a trick any way you want to look at it. Instead of coming out boldly like a man and supply a straightforward answer to a perfectly simple question, here he was taking advantage of my good nature and forcing me to answer a silly one of his. Some people have no conception of the social amenities. I told him so.

"What do you want me to do?" I asked. "Give you a blueprint and a set of specifications? Next time I want to ask you a question I will send a special delivery letter or, better still, if I can find such a thing I will despatch a special messenger in a rubber tired buggy. He will deliver the monogramed and delicately scented missive into the hand of your personal valet and wait humbly on the back steps for your gracious reply." "I hoid ye de foist time," Bill remarked calmly. "I ain't blind." He removed his pipe, spat with the nicest accuracy and apparently without taking the slightest aim between two of the upright members in the veranda railing. Then he returned the pipe to its place, hooked his thumbs in his belt, pushed his bonnet a trifle more to one side, crossed one long leg over the other with the most deliberate laziness. "Now, my dear child," said he, "kindly repeat your question. In other words come again. I don't get you. What's on your mind?"

Such brazen effrontery will get that fellow into trouble some day. Just to be friendly, to get away to a flying start I had couched my question purposely in his own style of language and here he was deliberately putting on the high hat and I suppose—to use another one of his vulgar expressions—expecting to get away with it. such gall! Such cheek! Such impudence! Such—such—Dash it all, I wished I had a baseball bat to tap the high hat down about his ears!

"Listen," I said "That is if you possibly can use your long ears for any other purpose than flicking the flies from the back of your neck. Have you decided finally to withdraw temporarily for a brief period from the scene of your daily activities for the purpose of sojourning for a few days in the well known city of Chicago where I have it on fairly reliable authority the American Foundrymen's association contemplate holding a convention during the week commencing June 6 and ending on Friday the 10th proximo. There you have it in a word. Short and snappy. Yes or no?"

"Far be it from me," Bill replied, "To keep any earnest seeker of useful knowledge in suspense. Still further be it from me to provoke any of God's creatures—a charitable supposition in your case—to such a wild and indiscriminate massacre of the English language. Brevity is the word, me lad. The word is yes."

"You might have said so at first," I reminded him, "Without all this circumlocution. One of your favorite hobbies in the shop is cutting corners and saving time, yet here you deliberately waste my time and your own pretending you did not understand the meaning of the term all set. Why you old walrus, I have heard you use the expression yourself a million times more or less since the expression insinuated itself into our spongy language a few years ago."

"Well," said Bill, "I'll tell you. I was just kind of practising on you. Trying it on the dog first."

"Indeed?" I inquired with the proper rising inflection. "If I am not violating any confidence would you mind telling me where you—er—ah—where you get this dog stuff?"

"Don't mention it," Bill remarked airily. "Not at all. Anything to oblige a friend. That little fancy touch about the dog merely is a parable, an allegory or what have you and is not designed in the slightest jot or tittle—whatever they are—to reflect on your person or your ancestry. I don't need to smile when I say it.

"Here's the dope. So long as I am home, dealing with people I know, I lay all the cards on the table. Every thing is open and above board. If a man asks me a question I answer him freely and to the best of my knowledge and ability. Nothing hidden, nothing concealed in either sleeve. I am one of the gang and regard every man—well, perhaps with one or two exceptions—as a brother. Old Simple Simon himself could show me nothing in

OUR HERO TAKES HIS CONSTITUTIONAL BEFORE BREAKFAST

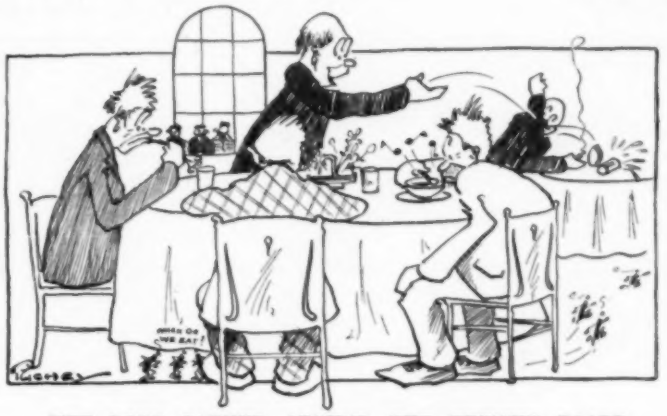
the trust and confidence I repose in my fellow man.

"When I ramble into foreign territory and am forced to circulate among strangers I don the old hard boiled armor and claim kinship with the lad who came from Missouri. I have to be shown. Many years ago I discovered the disconcerting value of answering one question by asking another. This simple little subterfuge throws the other fellow on the defensive and forces him to attempt an explanation. If he comes through in good shape all well and good. No harm done. If he falls down on the job I can either ignore him or hit him a poke on the nose depending on local conditions, the character of the question, and the size and physical condition of the nosey bird who picks me for an easy mark." "After such a declaration of policy," I said. "I shall not be surprised to learn that you also contemplate taking a bullet proof vest, a tin hat, a pair of shin guards and maybe a pair of bumpers to wear fore and aft to ward off stray bullets and collisions with the proletariat who swarm in the streets of that wicked town. While you are at it, you might pack a gun under your armpit for long distance work and a set of brass knuckles, right and left for the benefit of those intimate gentlemen who absent mindedly mistake other people's pockets for their own."

"No," said Bill, "I don't think I shall need any of that rigging. Chicago may be a wicked city in spots where citizens and near citizens and others who are neither one nor the other occasionally get bumped off. I have no ambition to act either in the role of a bumper or a bumpee, therefore I don't expect to get mixed up in any rough house stuff. I may take a genteel whirl or two on the convention floor with some of the boys who present papers that are over my head, but that is a game in which no one ever is hurt, or even convinced.

"Anyway," said Bill. "Most of this popular opinion about the dangers of Chicago is all my eye. Any person who goes there and minds his own business is in no more danger of a sudden and violent death than he is in any other town or village in this well known land of the free with its flocks of honking automobiles s w o o p i n g around every corner.

"Although known by name or reputation to every one of the army of foundrymen who will attend the convention of the American Foundrymen's association, many who will see the city of Chicago for the first time will have to revise many of their preconceived opinions. It is the second largest city on the American continent and ranks well up among the largest cities in the world. Those who only see it occasionally never cease to marvel at the virility, growth and bustling spirit which pervades this handsome city of the middle west with its wide streets and avenues, its extensive parks and the magnificent boulevard that skirts the lake shore for miles and miles.



THE BOYS GATHER AROUND THE FESTIVE BOARD

"They find it hard to realize that a little over 100 years ago this was only a little trading post in the vast American wilderness. A swampy land apparently unfit for human habitation, the home of vast numbers of aquatic wild fowl during certain seasons of the year when these wandering Ishmaelites paused temporarily in their northern and southern migration to feed in the luxurious rice fields. The only other sign of life was roving bands of Indians, nomads with no fixed habitation, with tomahawk and war bow constantly raised against each other and against the incursions of the white man slowly and irresistibly pushing them toward the last and far western frontier.

"Approaching the city from the east, one passes through the great steel mill towns of Gary and Indiana Harbor, where a mighty modern industrial Vulcan stripped to the buff blows his roaring fires and with ringing strokes on his anvil hammers out shining steel rails, plates and structural shapes without number. Day and night the flood of iron pours from the blast furnaces, flaming steel bubbles and boils in the open hearth furnaces, incandescent ingots are whipped out of the inferno of the soaking pits and driven through the remorseless rolls. A busy place if you ask me with its hundreds of smoke stacks, clouds of smoke and a smell! Boy, what a smell! Have you ever sprinkled water on hot ashes?"

"What is the idea of telling me all these things?" I asked him. "I have been into and out of Chicago many times and I have been familiar with the general characteristics of steel mills ever since I can remember. What do you expect one to smell like, a rose garden? What you need is a bottle of smelling salts in one hand or, better still, have a veterinary stick a ring in your long nose. Then you will have something besides the delicate and mixed aroma of tar, sulphur, ammonia, steam and smoke to engage your attention." "Never mind about the ring," said Bill. "And the rest of it. Fortunately for you I am a patient and forgiving individual. Otherwise it is not a ring you would need in your beak, but a pair of splints to hold it in shape. Reference to the steel mills was only incidental. What I had in mind, was that these big, bustling steel mill towns on the edge of the city convey to the mind forcibly how rapidly this section of the country has developed and become populated in such a comparatively short period of time."

Bill and I blew into Chicago early Monday morning after a more or less fairly comfortable night's run on a sleeper. Quite a contrast, Bill remarked reminiscently, to the manner in which he had arrived on his first visit many years ago. On that occasion the journey had consumed the better part of two days owing to the activities of certain gentlemen who insisted that he should change cars at several places en route. They even went further. Each time he was pushed off the brake rods with the end of a club he was invited in the most persuasive terms to remain for an indefinite period as the guest of the town. Refusing these kind invitations grieved him sorely, but as he explained to his would be hosts—usually quite hurriedly—Chicago was his ultimate destination and he had to be on the way. These hospitable citizens were so insistent that sometimes he had to run half a mile before he could convince them that he was in earnest. He appreciated their mistaken kindness, but it interfered sadly with his schedule. Each time he crept on the rods, the roof or the end of a blind baggage he reflected bitterly there should be a law or something to protect innocent interstate passengers

from incessant and unnecessary forms of interruption. A fine free country indeed. Bah! A couple of Bahs!

Shortly after we arrived at the hotel, Bill discovered a crowd of old cronies and I only had a fleeting glimpse of him now and again until the night of the annual banquet. We sat at the same table with several other sociable lads in good trim. They are staid, respectable citizens at home, but for the time being they conveniently shed all restraint and talked and laughed with all the careless abandon of a bunch of boys down at the old swimming hole.

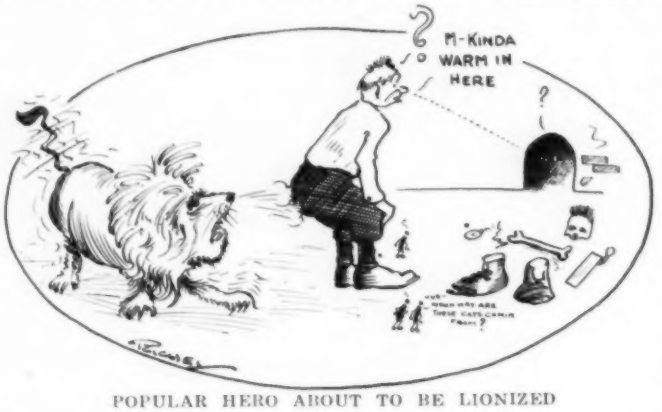
In fact accidental reference to the same old swimming hole turned the conversation on the recent Mississippi floods and that in turn moved one of the lads to ask Bill a question. He said that recently he had read an article in a popular magazine in which reference was made to the cast iron columns supporting the porch on an old Southern mansion. The author claimed these columns were made by the charcoal process which insured a beautiful finish on the surface and an iron impervious to rust. The lad wanted to know if Bill was familiar with the process. Also he said that at one time he had seen a collection of miscellaneous artistic iron castings made in Germany. Although made many years ago there was no sign of corrosion and the surface was as smooth as satin. He had been told that cast iron statues had been exposed to the weather in Germany for the past 150 years without showing a blemish. He asked if this also was due to the charcoal process.

"Well," said Bill, "I'll tell you. Some of these birds who set up as authors ought to be arrested and put to work at something within their capacity. Picking oakum, for example, or breaking the big ones into little ones. Careless ignorance on the part of the author of the article on southern mansions is responsible for the statement that the beautiful finish and long life of the columns are due to a method vaguely referred to as the charcoal process."

"In the period usually referred to as before the war, when these southern mansions were built and ornamented with cast iron pillars, iron ore was reduced in furnaces which employed charcoal for fuel. This kind of iron still is made to a limited extent and is known as charcoal iron to distinguish it from the variety made in furnaces where coke is used.

"Without entering into a discussion on the reasons for the difference, it is sufficient for your purpose to know that iron melted with charcoal fuel possesses superior physical properties over metal melted with coke. All cast iron will resist corrosion to a remarkable extent when simply exposed to the air.

"On account of the chilling effect produced by a cold mold, the skin on all iron castings is denser than the metal inside. Experiment has shown that this dense skin or scale is more rust resistant than the remainder of the metal. The grain structure of charcoal iron is denser



POPULAR HERO ABOUT TO BE LIONIZED

all the way through than iron made in a coke fired furnace and the skin is correspondingly closer and more resistant to corrosion."

"The foregoing disposes of the mythical charcoal process and explains why the columns show no sign of decay. Under favorable condition cast iron will resist corrosion almost indefinitely. Cast iron water pipes in a perfect state of preservation were dug up recently in Paris after being in constant use for over 200 years. The famous pillar of Delhi in India was erected 2000 years ago and apparently it is in as good condition now as when it was set up."

"Several methods are available for coating the surface of castings exposed to conditions favorable to corrosion. In the process known as the Bower-Barff, the castings are exposed to a low red heat in special ovens, furnaces or retorts and subjected to the action of superheated steam and various gases alternately or in combination according to variations of the process. An interesting article *Protecting Stove Tops from Rust* was published in THE FOUNDRY Jan. 1, 1920. The article describes an improved application of the process in treating malleable iron castings. Briefly it may be described as follows:

"Castings first are sandblasted and then preheated to a temperature of approximately 1500 degrees Fahr., in a closed muffle. A partial vacuum is developed in the oven and then superheated steam at a temperature of 750 degrees Fahr. is admitted under about 4 pounds pressure. The partial vacuum removes a portion of the gas in the muffle and permits the steam to act freely on all surfaces of the castings. After approximately 4 hours treatment the castings are removed and dipped in a mixture of linseed oil and a balsam known as *fermaline*. The action of the oil changes the dull gray color of the castings to a black mat or coating highly resistant to ordinary oxidizing influences. Design and operation of the equipment play an important part in the process. The collection of foreign castings to which you refer in all probability was treated in that manner."

"If I had time I should like to say a word about the big iron statues, but I see the chairman is getting ready to introduce the unfortunate speakers of the evening. Whenever I attend one of these blowouts I am reminded of the story of the two lads standing in front of a picture of Daniel in the lions' den. One said, 'How do you account for the peaceful and happy expression on the guy's face?' 'Well,' the other bird comes back. 'Why not? He knows there ain't goin' to be no after dinner speeches!'"

Detroit Foundrymen Elect Officers

On May 26 the Detroit Foundrymen's association held its annual banquet and election of officers at the Waddell apartments. Hon. Judge John Brennan, presiding judge, recorders court, and Stuart Wells Utley, president, American Foundrymen's association were speakers. Officers elected are: J. J. Boland, Griffin Wheel Co., president; Russell M. Scott, Packard Motor Car Co., vice president; Robert Hope, Holley Carburetor Co., secretary, and Fred A. Cowan, W. R. Thompson Co., treasurer. Members of the executive board are: James L. Mahon, American Car & Foundry Co.; Peter W. Mulder, Almont Mfg. Co., Almont, Mich.; George L. Grimes, Grimes Molding Machine Co.; Fred J. Walls, Wilson Foundry & Machine Co., Pontiac, Mich.; and Harry Rayner, Dodge Bros.

Improve Quality of Gray Iron By Heat Treating

By O. W. Potter

This is the second section of Mr. Potter's paper, which was presented before the Brussels congress of the Association Technique de Fonderie de Belgique. The first section appeared in the June 1 issue.—The Editors.

BROKEN specimens from the transverse test of small bars were tested in impact without notching on an Charpy impact machine. These were taken to ascertain the comparative toughness with and without heat treatment. Cast iron usually is considered as a brittle material but a knowledge of its resistance to shock is an essential and important factor in the proper use of the material. Some of the important conclusions from this test are

1. Most any form of heat treatment improves toughness.

2. Heat treatment No. 5 (heating to 1600 degrees Fahr. holding for two hours and air cooling) gave the best impact values.

It was desirable that some sort of indication of machinability be obtained. Since no abrasion testing apparatus was available an ordinary power hack-saw was used. The feed was removed and cutting was done under the weight of the saw frame itself. For standardization, a bar of hot rolled soft steel was used. A new blade was used for each set of specimens, first cutting the standard steel bar and then the three samples of any group. The time to cut through a 0.80 inch diameter was recorded by a stop watch in seconds.

The following was noted from the test:

1. A wide range of time was required to saw the bars and some bars were too hard to saw with the blades used.

2. Specimens subjected to heat treatment No. 5 (heated to 1600 degrees Fahr., held for two hours and air cooled) machined almost as easily as the softest specimens.

3. The specimens under heat treatment No. 6 (quenched and drawn at 600 degrees Fahr.) were almost impossible to machine; all samples spoiling a new saw blade with the exception of the P series in which two specimens were cut through before failure of the blade.

4. Annealing at high temperature tended to produce a uniform hardness regardless of the kind of material and original hardness.

Thermal analyses was made on four specimens which varied considerably in chemical analysis. Time was recorded for equal advances in temperature giving the inverse rate type of cooling and heating curves. The recording apparatus on the electric furnace, used in the last series

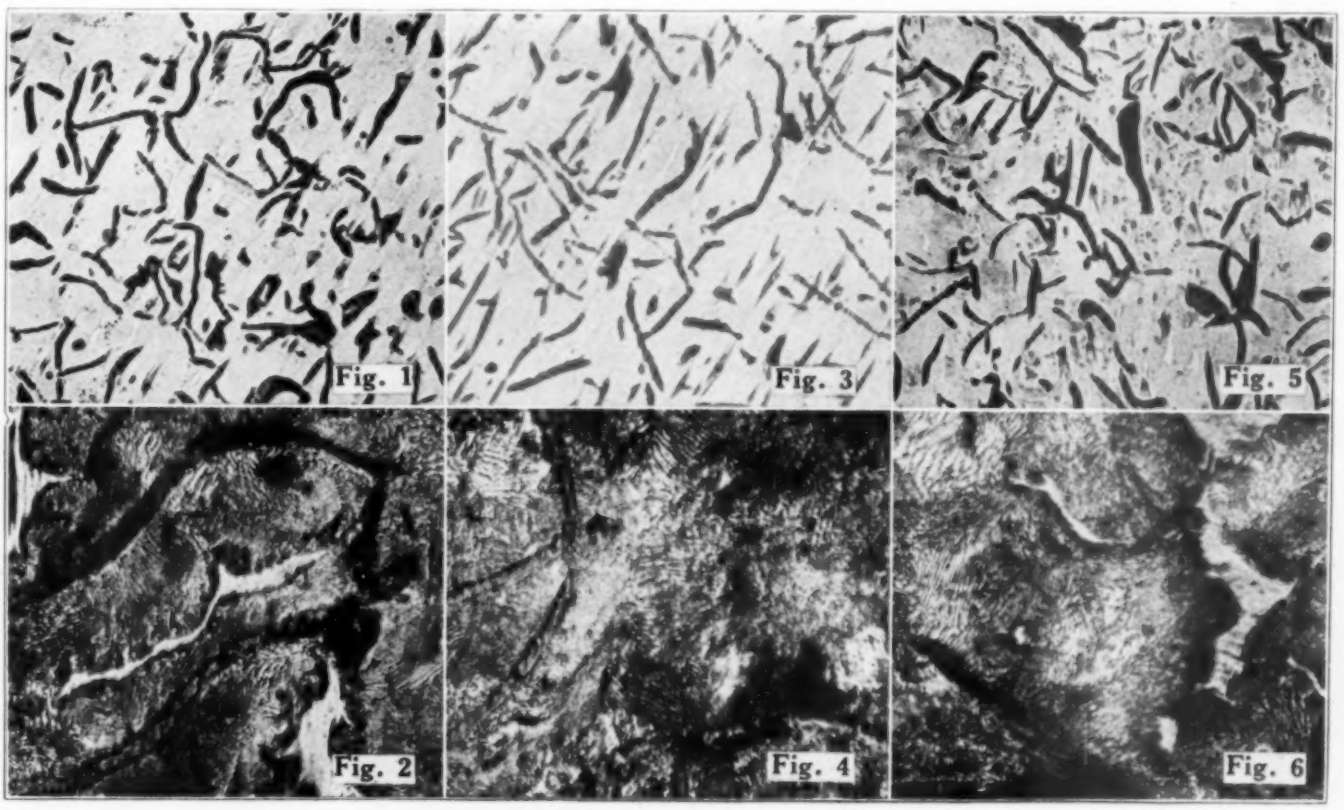


FIG. 1 *A*—UNTREATED, RELIEF POLISHED, X 100. FIG. 2 *A*—UNTREATED, ETCHED WITH PICRIC ACID, X 500. FIG. 3 *A*1—ANNEALED AT 500 DEGREES FAHR., RELIEF POLISHED, X 100. FIG. 4 *A*1—ANNEALED AT 1000 DEGREES FAHR. ETCHED WITH PICRIC ACID, X 500. FIG. 5 *A*2—ANNEALED AT 1000 DEGREES FAHR., RELIEF POLISHED, X 100. FIG. 6 *A*2—ANNEALED AT 1000 DEGREES FAHR., ETCHED WITH PICRIC ACID, X 500

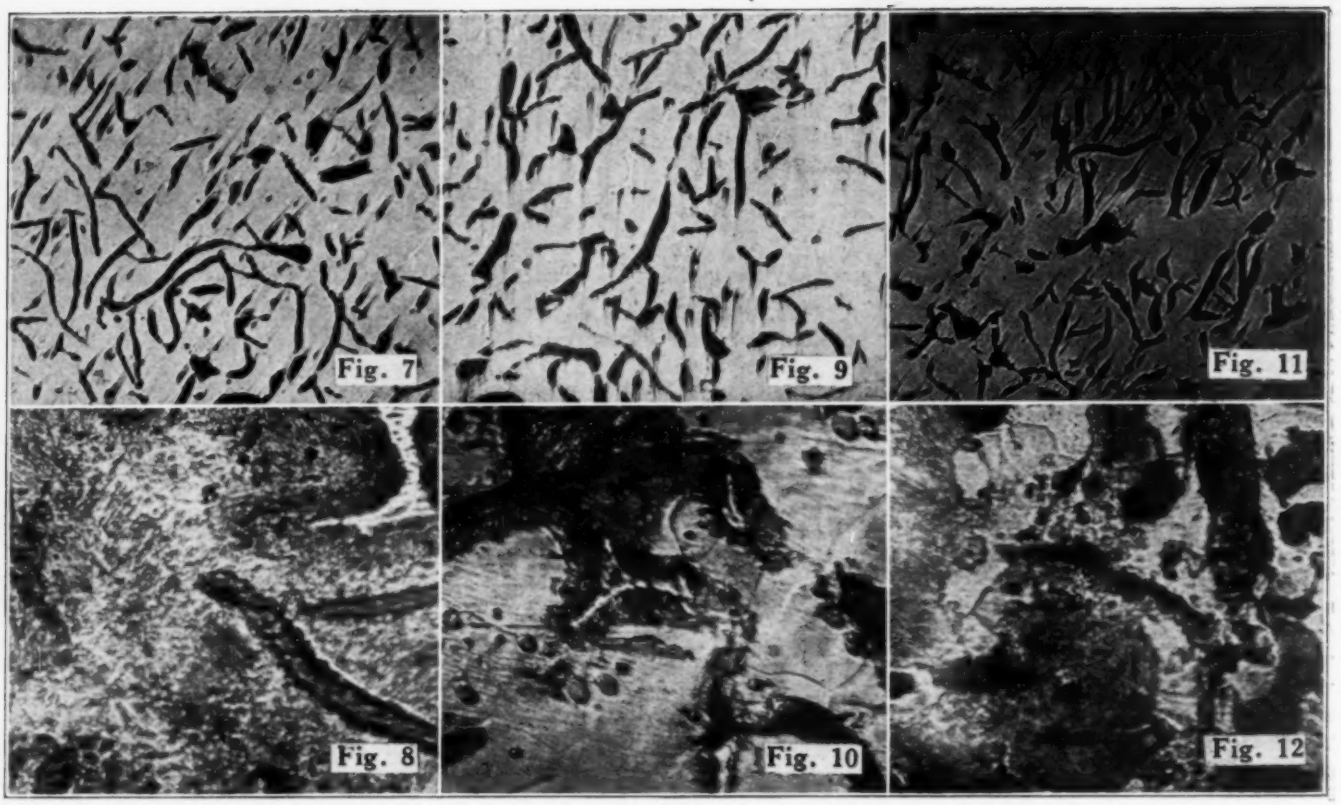


FIG. 7 *A3*—ANNEALED AT 1350 DEGREES FAHR., RELIEF POLISHED, X 100. FIG. 8 *A3*—ANNEALED AT 1350 DEGREES FAHR., ETCHED WITH PICRIC ACID, X 500. FIG. 9 *A4* HEATED TO 1600 DEGREES FAHR., COOLED SLOWLY IN FURNACE RELIEF POLISHED, X 100. FIG. 10 SAME AS FIG. 9 ETCHED WITH PICRIC ACID, X 500. FIG. 11 *A5*—HEATED TO 1600 DEGREES FAHR., HELD TWO HOURS, AIR COOLED, RELIEF POLISHED, X 100. FIG. 12 SAME AS FIG. 11 ETCHED WITH PICRIC ACID, X 500

of experiments, gave the average critical for the six different materials used at about 1450 degrees Fahr. The critical range for cast irons corresponds closely to that of steels of corresponding combined carbon contents. The effect of the other elements is to vary this range somewhat, but the elements producing

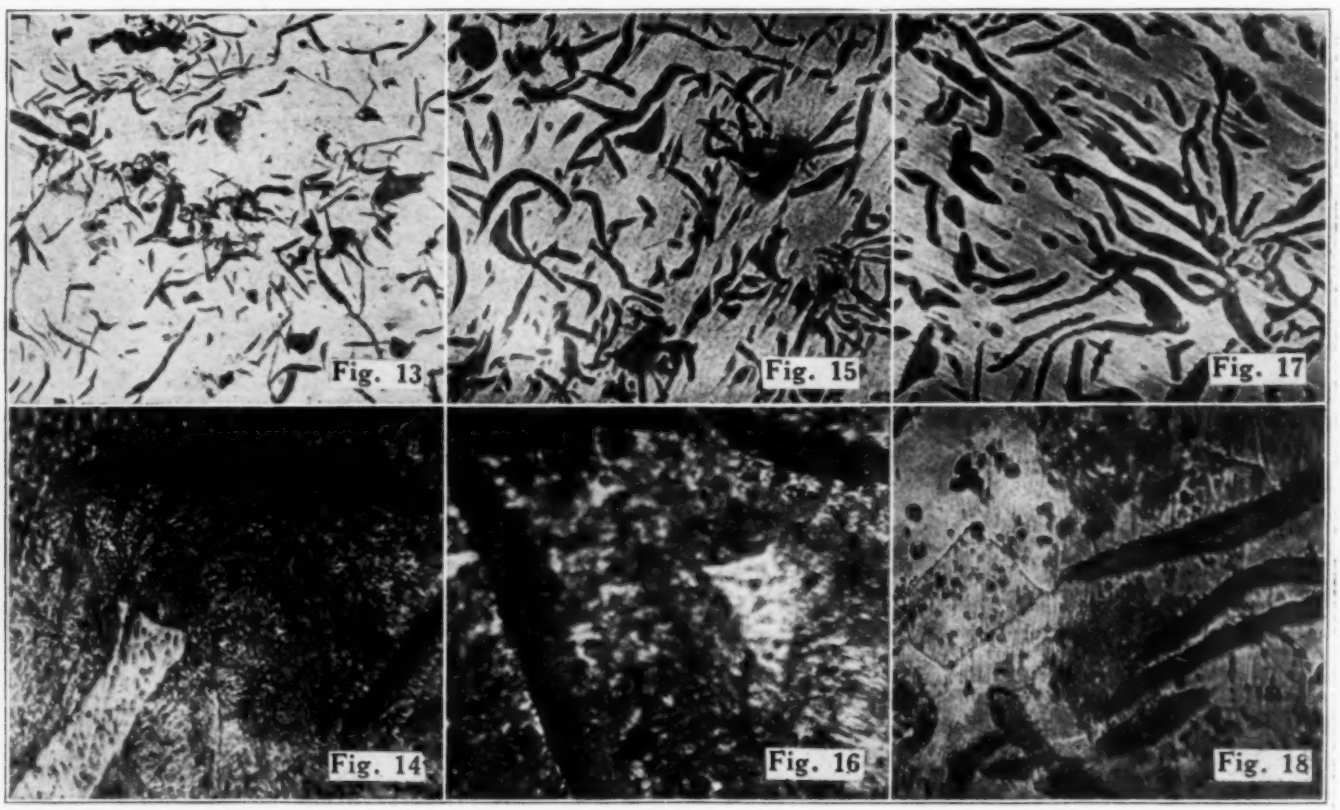


FIG. 13 *A6*—HEATED TO 1600 DEGREES FAHR., WATER QUENCHED, DRAWN AT 600 DEGREES, RELIEF POLISHED, X 100. FIG. 14 SAME AS FIG. 13 ETCHED WITH PICRIC ACID, X 1000. FIG. 15 *A7*—HEATED TO 1600 DEGREES FAHR., WATER QUENCHED, DRAWN AT 1000 DEGREES, RELIEF POLISHED, X 100. FIG. 16—SAME AS FIG. 15 ETCHED IN PICRIC ACID, X 1000. FIG. 17 *A8*—HEATED TO 1600 DEGREES FAHR., WATER QUENCHED, DRAWN AT 1300 DEGREES, RELIEF POLISHED, X 100. FIG. 18 SAME AS FIG. 17, ETCHED WITH PICRIC ACID, X 500

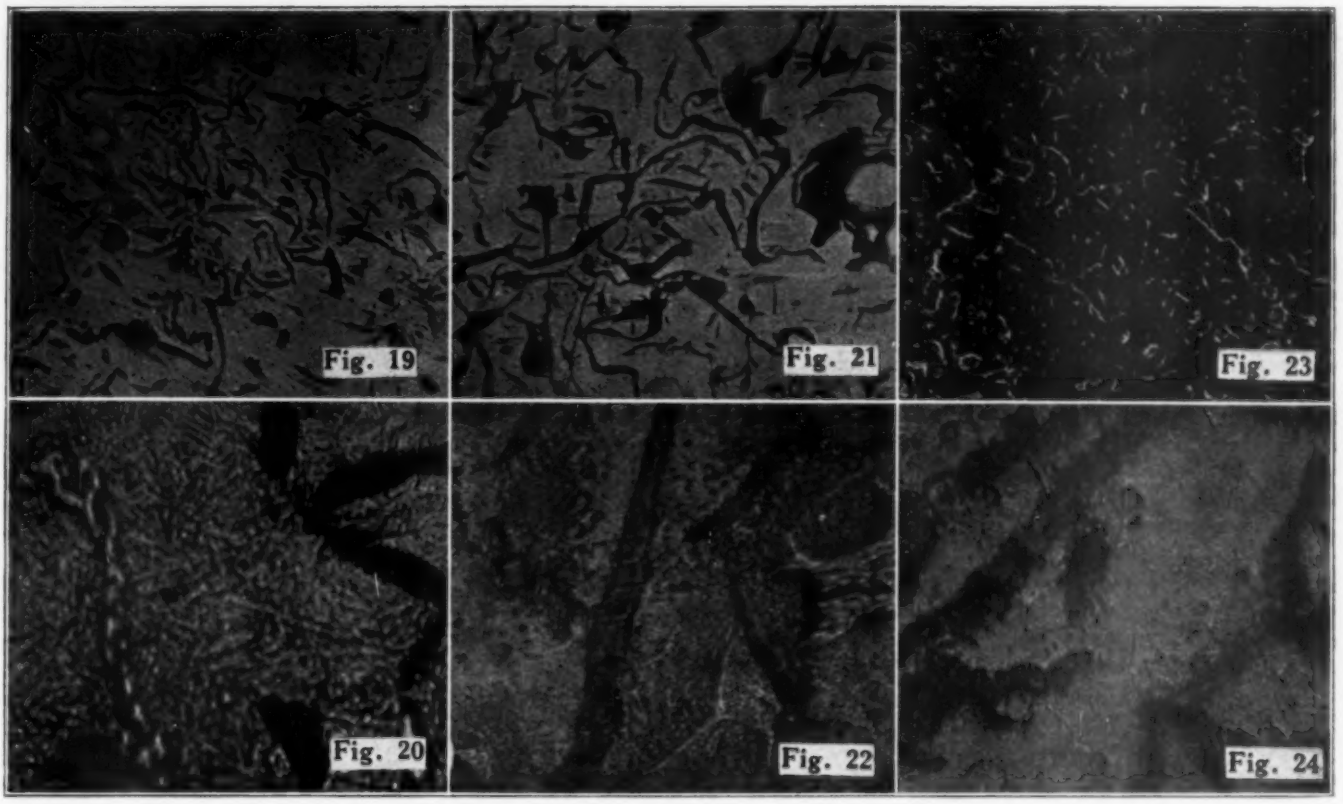


FIG. 19 *A9a*—HEATED TO 1600 DEGREES FAHR., HELD FOR 3 HOURS, AIR COOLED, REHEATED TO 1600 DEGREES AND WATER QUENCHED, RELIEF POLISHED, X 100. FIG. 20 SAME AS FIG. 19, ETCHED WITH PICRIC ACID, X 100. FIG. 21 *A9*—SAME TREATMENT AS FOR 9*a* AND THEN REANNEALED AT 1600 DEGREES FAHR., RELIEF POLISHED, X 100. FIG. 22 *A9*—SAME TREATMENT AS IN FIG. 21, ETCHED WITH PICRIC ACID, X 500. FIG. 23 *P*—NETWORK STRUCTURE OF PHOSPHORUS, EUTECTIC, STEADITE, ETCHED WITH 10 PER CENT NITRIC ACID, X 50. FIG. 24 *CI*—ANNEALED 1600 DEGREES FAHR., SLOW COOLING, REHEATED TO 1670 DEGREES, WATED QUENCHED, ETCHED WITH PICRIC ACID, X 500

the most effect are silicon and manganese. It was concluded from the first set of experiments that the critical temperature for cast iron may be determined accurately by the following formula:

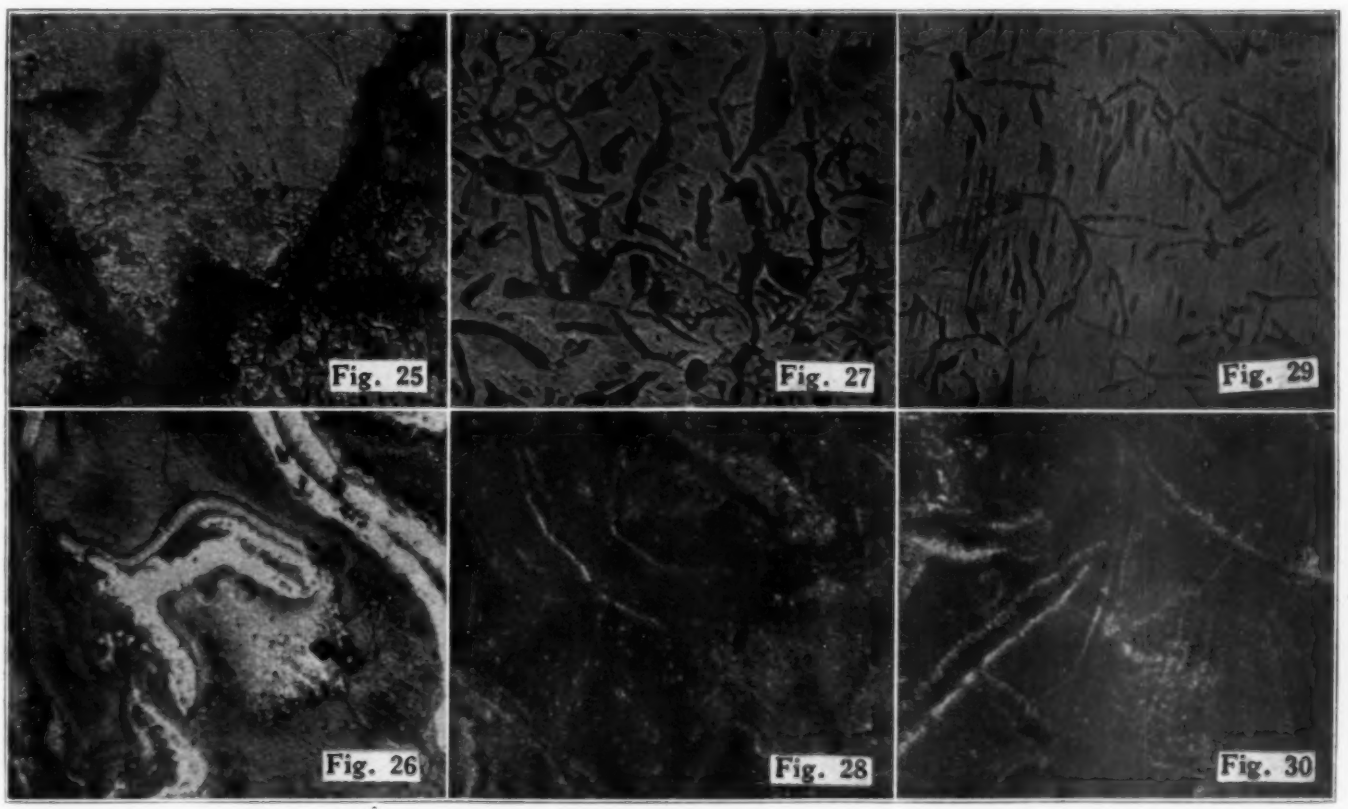


FIG. 25 *CI*—ANNEALED AT 1600 DEGREES FAHR., SLOW COOLING, REHEATED TO 1670 DEGREES, OIL QUENCHED, ETCHED WITH PICRIC ACID, X 500. FIG. 26 *SS*—WATER QUENCHED FROM BELOW CRITICAL, ETCHED HOT SODIUM PICRATE, X 1000. FIG. 27 *P*—RELIEF POLISHED, X 100. FIG. 28 *P* ETCHED WITH PICRIC ACID, X 500. FIG. 29 *P4*—HEATED TO 1600 DEGREES FAHR., COOLED SLOWLY IN FURNACE, RELIEF POLISHED, X 100. FIG. 30 SAME AS IN FIG. 29, ETCHED WITH PICRIC ACID, X 500

Critical Temperature = 730 degrees Cent. + (28 x per cent Silicon) - (25 x per cent Manganese)

This formula gives the critical temperatures for the A to U series as follows:

Sample No.	Silicon	Manganese	Critical Temperature, degrees Fahr.
A(SS)	1.58	0.80	1389
M(SS)	1.84	0.42	1420
P(CI)	2.77	0.71	1454
1S(CI)	1.72	0.59	1405
2S(SS)	1.26	0.64	1380

A study was made under the microscope to aid in the determination of the causes of variation in the physical properties. A complete set of micrographs for each heat treatment of sample A are shown in Figs. 1 to 22 inclusive.

It is apparent that there is no appreciable change in graphite flakes when annealed at 500, 1000 and 1350 degrees Fahr., or below the critical. However, at 1350 degrees Fahr., when etched in picric acid there is a breaking up of the laminar pearlite to granular pearlite and there is quite an apparent migration of the carbon particles towards the larger graphite flakes. This was much more apparent through the microscope than is shown in the micrographs presented.

Light areas appearing in relief on the unetched micrographs and the same appearing light and unetched in the etched specimens likely are seemed to encircle the original grain phosphide eutectic (steadite). These boundaries of the primary austenite. This is quite visible when etched with 10 per cent nitric acid and viewed at 50 magnification. Since the phosphide is the last thing to solidify, it is at the grain boundaries, as would be anticipated. Since the austenite grains change to pearlite in the process of cooling their boundaries no longer are visible only as indicated by the network structure of the eutectic steadite as shown in Fig. 23.

Graphite Migrates

Specimens heated above the critical show larger graphitic flakes as shown in Figs. 9 and 11. On slow cooling the carbon migrates to the graphite flakes leaving a solid solution background of ferrite and silicon as in Fig. 10.

On air cooling, the migration of the graphite is retarded, the region next to the graphite flakes alone being affected. The amount of migration seems to be proportional to the rate of air cooling and under proper conditions might be eliminated. This would give a maximum strength with minimum hardness. The physical tests appear to substantiate these conclusions.

Micrographs shown in Figs. 13 to 18 inclusive show the appearance of specimens quenched from above the critical and drawn at different temperatures. Quenching from above the critical in either water or oil gives a martensitic matrix. Fig. 14 shows this structure just beginning to break down under the drawing process. Fig. 16 shows a sorbitic matrix and Fig. 18 only a small amount of granular pearlite with a solid solution matrix. It also is apparent in the relief polished specimens that the graphite flakes are larger and that some temper carbon also is present.

Annealing above the critical followed by quenching from above the critical gives a characteristic martensite. This material was exceedingly hard and brittle and had to be reannealed before samples could be machined. This reannealing resulted in a granular pearlitic matrix. There was considerable temper carbon present also. This is shown in micrographs of Figs. 19, 20, 21 and 22.

Quenching from extremely high temperatures seems to cause a spherodizing of the graphite as shown in Figs. 24 and 25.

Specimens Show Ferrite

Specimens which were annealed at extremely high temperatures or allowed to cool slowly showed a background matrix which seemed to be ferrite. Upon etching in hot sodium picrate it was discovered that only narrow strips around the graphite flakes could be regarded as pure ferrite. This is shown in Fig. 26. Otherwise the main background matrix material then must be a solid solution. Since there is considerable silicon present in all cast irons, it may be in solution with the ferrite. This background matrix is probably a solid solution of silicon, carbon, and phosphorous in ferrite. It might be a form of austenite, but due to the large amount of silicon present it probably is not to be considered as austenite. This phenomena also seems to indicate that graphite continues to migrate and is precipitated after the other constituents are established. The same condition was noted on some of the quenched specimens. Along with the above there seems to be a breaking down of the instable phase cementite (Fe_3C.)

High silicon irons are characteristically different from the low silicon iron, Figs. 27 to 30. There is noticeably more graphitic flakes, more steadite because of high phosphorous, and less pearlite, even in the untreated specimens. This form of the original structure no doubt accounts for the contrary behavior of the physical properties of the high silicon irons when subjected to heat treatment.

Hardening constituents in cast iron are combined carbon, manganese, phosphorous, and sulphur; combined carbon being the most potent. Graphs were prepared to show the relation between the hardness and total, combined, and graphitic carbon. Since silicon really is the controlling agent for the graphitic carbon, silicon content and hardness, only the values for the untreated specimens are used. It was seen clearly from these graphs that the scleroscope hardness index is not a definite indication of any characteristic property while the brinell tests in all cases seem to give a better relatives indication of properties. In one graph the brinell indicates definitely a softening with increase in total carbon when the silicon content is below 2.00 per cent. This would seem to indicate that silicon above 2.00 per cent has effects on the hardness other than the precipitation of the graphite.

The brinell hardness numbers are directly proportional to ultimate strength as in other alloys. The scleroscope index usually is considered proportional to elastic limit in the steels and nonferrous alloys. It is known that the elastic limit of cast iron is a variable quantity ranging from almost nothing to near the ultimate strength, depending on the particular constituents present and their physical condition, and relation to each other. Hence further investigation may indicate a relationship between the scleroscope index and some of the other properties of cast iron.

Gives Summary

An analysis of the results obtained from the heat treating tests may be summarized as follows:

1. The strength properties are increased substantially by annealing at temperature below the critical, due to the removal of casting strains.

2. The heat treatment which gave maximum softness and machinability with the minimum of reduction in strength properties was No. 5 (heated to 1600 degrees Fahr., held for two hours and air cooled).

3. The elongation of cast iron in tension is extremely small. It is increased slightly with anneals above the critical.

4. Deformation before rupture is

increased by all form of heat treatment used.

5. The impact property is improved by heat treatment.

6. Gray cast iron may be made hard by water quenching from above the critical and also may be softened subsequently by reannealing.

7. The strength properties may be ruined almost completely by continued exposure to a high temperature.

8. The reduction of the strength properties by annealing was not as much with the high solution irons as it was with the high silicon irons as it was with the low silicon irons. The effects of the heat treatments on the high silicon irons seemed to vary considerably from those obtained with the lower silicon irons and in some cases were quite the reverse. However, it appears that it may be possible to obtain certain desired results from heat treatment with less risk of an excessive reduction of the strength properties.

9. The impact properties of the high silicon irons were the lowest of the series tested.

10. The combined carbon is reduced by annealing at any temperature; the higher the temperature the more rapid the breakdown.

11. The combined carbon content and the hardness may be increased greatly by quenching from above the critical.

To make this article of as much practical use as possible a questionnaire was sent to a number of the leading gray iron foundries in the United States to secure information concerning current practice with reference to the heat treatment of cast irons. A summary of the replies is as follows: Fifty-nine per cent of those replying are now heat treating some of their gray iron castings. One per cent in addition stated that they were in favor of the heat treatment of cast irons and thought that the trend of practice was in that direction.

Results Obtained

The results obtained in commercial practice as reported almost uniformly are as follows:

1. Uniform hardness.
2. Increased machining speeds.
3. Less wear on cutting tools.
4. Elimination of warpage.
5. Relieving of casting strains.
6. Reduction of rejections because of hardness and warpage.

Other properties reported as the result of heat treatment are as follows:

1. Improved impact properties.
2. Better wearing properties given.
3. Greater hardness (quenched specimens).

The automobile and tractor manufacturers all reported that they heat treated some of their castings. Jobbing foundries reported that casting users were becoming much interested in the heat treatment of the cast irons, and some were demanding it. Other manufacturers who are heat treating gray cast irons include agricultural implement manufacturers, power machinery manufacturers, machine tool builders, electrical machinery manufacturers, manufacturers of conveyor machinery, manufacturers of pistons and automotive accessories. In addition, reports were received from car wheel and cast iron pipe manufacturers whose processes for some time have included methods which are annealing processes.

Draws Conclusions

The conclusions developed from this investigation are as follows:

1. The properties of gray cast iron may be varied greatly under heat treatment.

2. Uniform results may be obtained by heat treatment within the limits of commercial control.

3. Great economy of the cost of machining may be obtained through reduced hardness.

4. Tool wear is reduced greatly.

5. Greater accuracy in machining may be obtained.

6. Warpage after machining may be eliminated to a large extent.

7. Growth difficulty is obviated largely.

8. Great hardness may be obtained.

9. Anneals at high temperatures for long periods of time and slow cooling greatly reduce strength properties.

10. The best heat treatment to give maximum hardness and minimum reduction of strength properties for the material investigated is to heat to 1600 degrees Fahr., hold for 2 hours and air cool.

11. It is claimed and generally accepted that better results are obtained when the products of combustion are not in contact with castings during heat treatment.

12. Annealing at 1000 degrees Fahr. and under appears to remove all casting strains, which reduces breakage in subsequent machining or failures through shock and impact.

13. The impact property is improved by heat treatment.

14. The correct critical temperatures for cast iron may be calculated with a fair degree of accuracy from the regular chemical analysis by the formulas which follow:

Critical temperature = 730 degrees Cent + (28 degrees Cent x per cent silicon) - (25 degrees Cent. x per cent Manganese)

Critical temperature = 1346 degrees Fahr. + (82.4 degrees Fahr. x per cent Silicon) - (77 degrees Fahr. x per cent Manganese)

15. The heat treatment of the gray cast irons of varying steel content (semisteel) and the alloy cast irons offer further fields for investigation. A thorough systematic study no doubt will reveal treatments which will benefit further the properties of the gray cast irons and prevent to a considerable extent the encroachment of the other metals and alloys on its field. It may even offer opportunities to enlarge the field of usefulness of the cast irons.

16. The adaption of some form of heat treatment by many of the large manufacturers should be sufficiently convincing to all gray iron foundrymen that the heat treatment of gray cast iron is past the theoretical stage.

17. More systematic research should be fostered by the gray iron foundrymen themselves to determine all the effects on gray iron of different chemical compositions, the effects of steel and alloy additions, the properties required under commercial use and the economic benefits possible. Actual facts derived from such experimental data will do much toward improving the quality of the gray cast irons and will convince the casting user of their value.

18. The brinell hardness test seems to be the best method available for cast iron and is in direct proportion to total carbon, combined carbon and ultimate tensile strength. The scleroscope harness index does not seem to follow any important property of cast iron in any apparent ratio.

It would seem then from these conclusions that the possibilities of an improved gray cast iron through heat treatment no longer is a dream but a reality, and all casting users and manufacturers therefore should be interested vitally. It is true that much research yet is needed to determine all the effects and conditions of good working practice. Manufacturers should organize a systematic program of research on cast iron, the effects of heat treatment and on the effects of the impurities on the properties.

E. R. Wyler who has been connected with the Cleveland branch of the Independent Pneumatic Tool Co., has been transferred to the Chicago sales department. He will make his headquarters in St. Paul.

GATING GOVERNS QUALITY

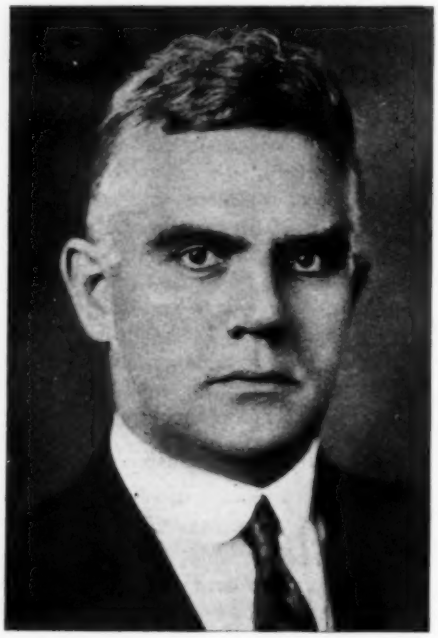
Typical Examples Are Presented of the Manner in Which Changes in Gating and Feeding Have Produced Clean Sound Nonferrous Castings

By R. R. Clarke

FOUR primary considerations attend the gating of nonferrous castings: Delivery of clean metal to completely fill the mold; protection of the mold and its parts against the action of heat, impact, erosion or pressure; compact and non partitioning state of metal delivery; feeding the casting against shrinkage. Practically all nonferrous gates or change of gates involve one or more of these factors.

Clean running and feeding of the casting are paramount features and virtually all remedial changes in gating reduce to corrective measures in either one or the other, or both. Practice for a long time has favored running and feeding a casting from the same point and through the one gate. Recently I have arrived at a different conclusion and now consider the two as separate functions. Where the best running and the best feeding points of a casting coincide I run and feed at that point. Where they lie apart I run the casting at one point and feed at the other. These features are shown in the accompanying illustrations reading down from the top.

Fig. 1 shows a transformer top, a broad mold gated straight in with a single gate *R*. Errosion and heat from the metal playing over the surface at *n o p*, causes the sand to buckle, peel and work away. Multiple gates *A-B-C-D-E* distribute the metal over a wider area and result in a clean casting.



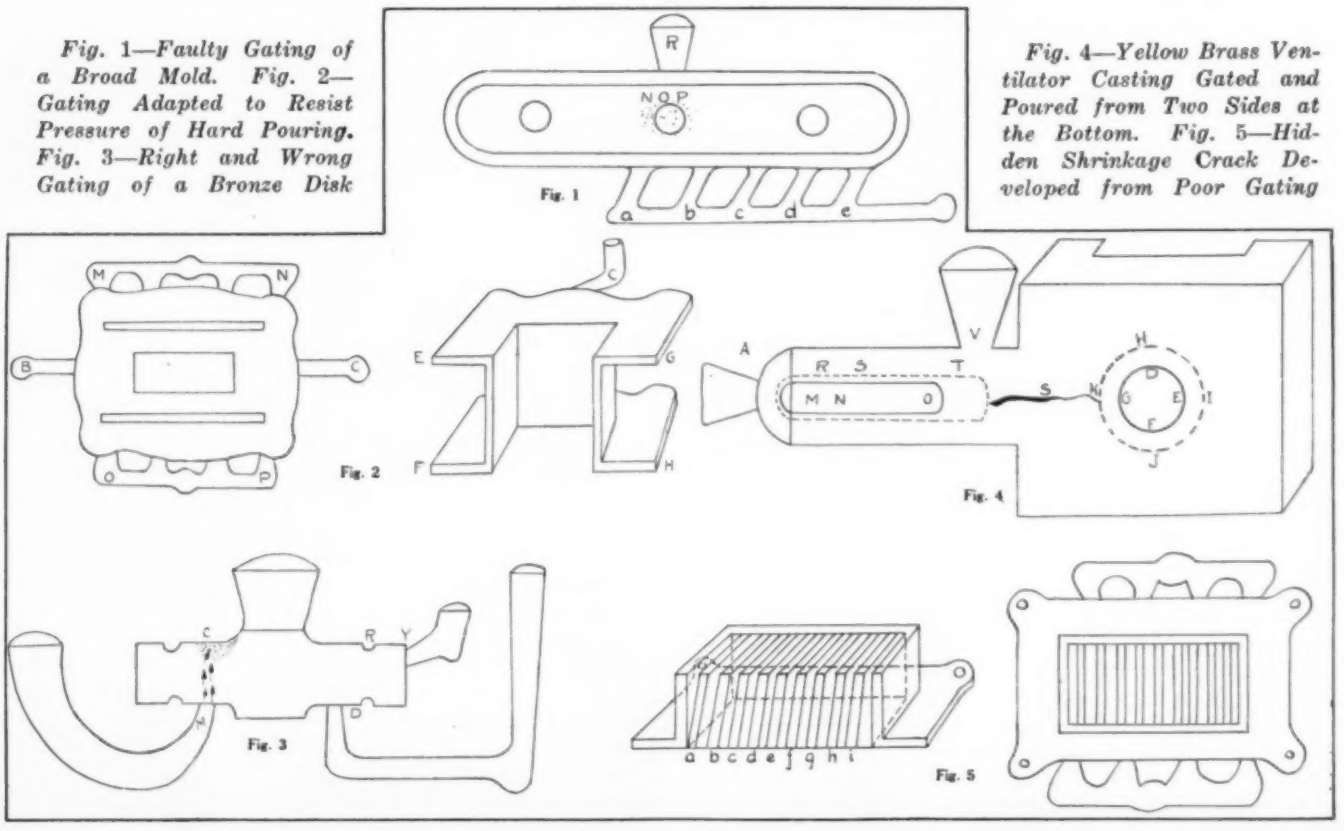
R. R. Clarke, the author of this article, which was abstracted from a paper prepared for the American Foundrymen's association convention in Chicago June 6 to 10, 1927, is nonferrous foundry superintendent at the Erie, Pa., works of the General Electric Co.

Fig. 2—In this illustration *M N* and *O P* indicate the pouring gates while *B* and *C* are risers or relief gates. This style of gating is adopted to relieve metal pressure due to hard pouring at the finish. The casting is a spool for coil winding and must be poured two-up, hot and hard. The walls *E-F-G-H* are thin and must be uniform. Despite the usual precautions, the upper flange strained when no relief gates were provided. After these gates were placed as shown, the trouble disappeared.

Fig. 3—This illustration is of a blank bronze disk originally gated at *M* where the metal spouted up violently and tore away the sand in the cope at *C*. A modified form of horn gate was placed at the point *D* and produced satisfactory castings. This item also illustrates the direction

Fig. 1—Faulty Gating of a Broad Mold. Fig. 2—Gating Adapted to Resist Pressure of Hard Pouring. Fig. 3—Right and Wrong Gating of a Bronze Disk

Fig. 4—Yellow Brass Ventilator Casting Gated and Poured from Two Sides at the Bottom. Fig. 5—Hidden Shrinkage Crack Developed from Poor Gating



of metal currents when driven through curved and angular gates. The objection to a straight in gate *Y* is that the metal washes a gap through the bead *R*.

Fig. 4—This is a yellow brass ventilator casting gated and poured from two sides at the bottom. When made originally with the flange up, 60 per cent of the castings were misrun in the thin webs *a-b-c-d-e-f-g-h-i-j k*. Under present conditions, with the flange down, with the gates at the bottom and with the metal rising from the bottom to the top a misrun casting is a rarity. One of the principal advantages of this method is that the gases generated in the thin bodies of sand between the webs travel ahead of the metal as the mold fills. No metal possibly can get into the top vents of the cores and thus trap gases until after the mold is filled completely and by that time the danger point is past.

Fig. 5—When this terminal casting was gated at *A* and drilled as shown by *M-N-O* and *D-E-F-G*, the metal apparently was solid. With a similar gate, but with the holes drilled much larger as shown by *R-S-T* and *H-I-J-K* a shrinkage crack *S* was discovered. Presumably this crack was present in former castings, but was undiscovered by the smaller holes drilled. A large gate and feeder at *V* cured this trouble.

Fig. 6—Illustrates change in form and size of feeders from a mere hole in the sand to a properly designed opening that fulfills a given purpose. To function properly a riser or feed gate must remain open and in fluid communication with the zone of final solidification in the casting. If the metal in the riser freezes before that in the casting it is obvious that it is of no service. Risers or feeders *A* and *B* in the example *M* illustrate this point. The gate and riser *D* and *C* shown in the middle example *N* are ideal and function as they were intended. They show a tapered feeding head terminating in a thin neck at the point where it joins the casting. A rather common error in feeding attempt is shown in the example *H*. Irrespective of the fluidity or volume of metal in the enlarged top of the reservior *O*, it is of no use to the casting if it freezes in the narrow neck *S*.

C. F. Hutchings, formerly New York representative of the tramrail division of the Cleveland Crane & Engineering Co., Wickliffe, O., has been appointed representative in charge of sales. The firm's New York office is at 30 Church street.

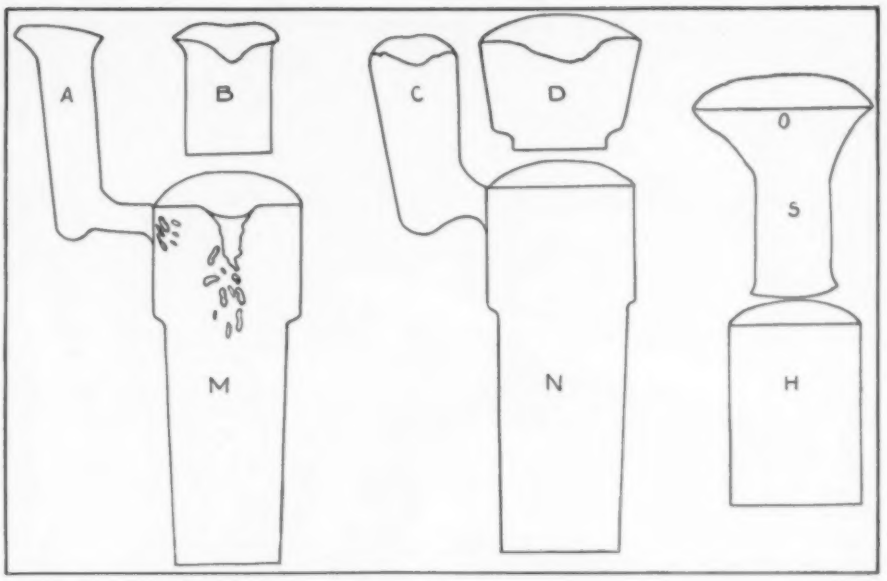


Fig. 6—Changing the Size of the Gate Frequently Provides Fluid Metal to the Point of Final Solidification

Old Timers Meet

The annual meeting and banquet of the veterans association of the Farrel Foundry & Machine Co., Ansonia, Conn., was held the afternoon of May 14 with Charles F. Bliss, president of the company, acting as toastmaster. The veterans association consists of employes who have been with the Farrel concern for 25 years or more.

The Farrel Foundry & Machine Co. is an old concern, having been established in 1848, by Almon Farrel and his son Franklin Farrel. The company first manufactured power drives and gears for installations which, at that time, ran by water power. Gradually the manufacture of rolling mills, calendars and other roll operating mechanisms, rubber machinery and sugar milling machinery, was introduced until today the company serves five basic industries, by the manufacture of metal rolling mills, rubber mill machinery, paper calenders, sugar mill machinery and plastic material machinery, and has expanded from a small plant on the banks of the Naugatuck river to 13½ acres of modern plant space at Ansonia, with a branch plant at Buffalo, which has three-quarters of the main plant's capacity.

The members of the veterans association have seen many changes during the time they have spent with the Farrel Foundry & Machine Co. There are 116 members of the association, all having been in the employ of the concern for more than 25 years. Thirty of these members are on the pension list. The president of the association, William Bowen, has been in the employ of the Farrel Foundry & Machine Co. for 55 years, while one other member has served for over 50 years and several for more than 40 years.

Now Is Sales Manager

J. P. Alexander recently has been appointed Boston manager in charge of all sales and service in New England territory by the Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa. He was born in Chambersburg, Pa., and attended Chambersburg academy. He was graduated from Lafayette college, Easton, Pa., in 1907 and became associated with the Westinghouse company that same year.

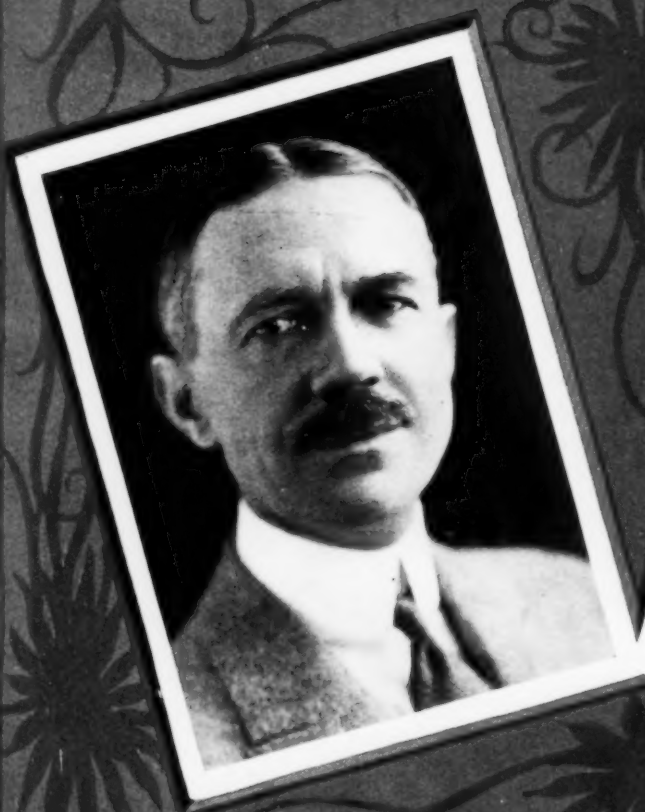
George H. Cox, who has been New England manager for the past 8 years, has been appointed sales manager at the South Philadelphia Westinghouse works. Mr. Cox has been associated with the company since 1912.

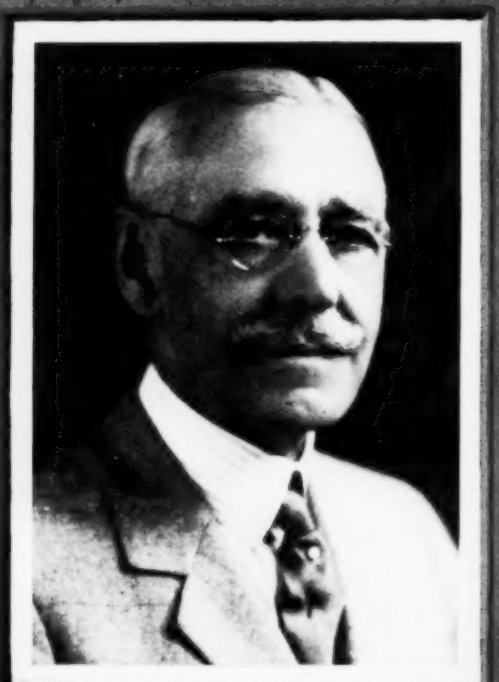
Changes Affiliation

L. S. Longnecker, formerly Pittsburgh representative for the Vitrefax Refractories Co., Los Angeles, Calif., recently has been appointed representative in the Pittsburgh and Cleveland districts for the Charles Taylor & Sons Co., Cincinnati. Previous to his connection with the Vitrefax company Mr. Longnecker was employed in the South Side plant of Jones & Laughlin Steel Corp., Pittsburgh, and was engaged in refractory experimental work.

Harnischfeger Corp., Milwaukee, has removed its Dallas, Texas, office from the Fidelity Union building to the Construction Industries building.

The FOUNDRY Family Photograph Album





Upper Left

H. W. Wolff, President American Car & Foundry Co., Chicago

Lower Left

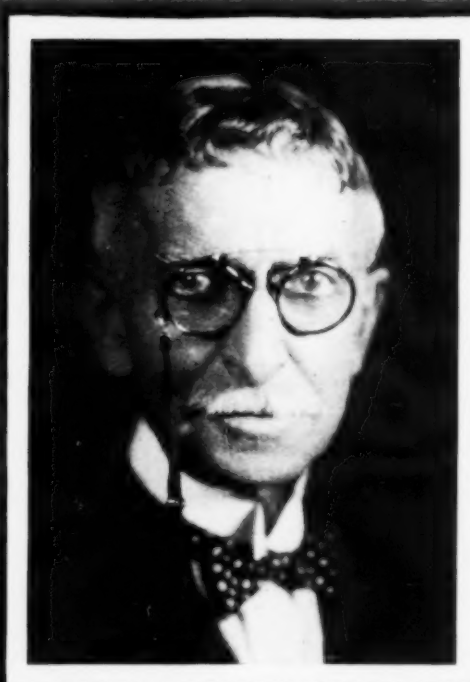
Frederic B. Stevens, Frederic B. Stevens Inc., Detroit

Upper Right

Robert E. Masters, San Diego, Calif.

Lower Right

Howard Evans, Secretary, Philadelphia Foundrymen's Association, Philadelphia



WHAT OTHERS ARE THINKING

Abstracts Selected from the World's Foundry Literature

Cupola Operation

On the Operation of Cupolas; Consequences of a Few Professional Mistakes, by A Metallurgist. *La Fonderie Moderne*, Jan. 1927. The article deals with bad results due to inexperienced handling. The author recommends the use of cupolas with several lines of tuyeres for foundries doing a regular job with charges of practically the same composition over a long period of time. For foundries that have to change the composition of their charges frequently a cupola with one line of tuyeres only is recommended. The author gives four examples of mishaps due to false economy of coke, to badly effected repairs to the refractory lining of cupolas, to an unsatisfactory tapping hole and bottom, and to the defective calculation of the amount of metal needed for a day's work.

Gives Grate Bar Data

The Composition of Fire Bars and their Resistance to Heat, by M. R. Stumper, *Chaleur et Industrie*, Paris, December, 1925, quoted by *La Fonderie Moderne*, February, 1927.

Grate bars are generally made of gray cast iron. Phosphorus and sulphur renders the bars brittle. Longer life of bars can be obtained by using higher grade cast iron. The German standardization committee recommends the following composition: Carbon, 3.5 to 4.0 per cent; silicon, 1.0 to 3.0 per cent; manganese, 0.3 to 0.8 per cent; phosphorus, 0.3 per cent maximum; sulphur, 0.08 per cent. Some also recommend chilled bars, or protecting them by a thin layer of aluminum. Sulphur exerts a detrimental chemical effect. Micrographic examination shows that the attack of gray iron bars takes place along the graphite flakes. The author concludes by stating that pig iron with a white fracture should be used owing to the greater resistance of cementite to attack.

Claim Fluorspar Valueless

The Effect of Fluorspar as a Cupola Flux in the Iron Foundry, by Ernst Wilke and Theodore Klingenstein, after experiments by Fritz Seiter, *Stahl und Eisen*, Jan. 27, 1927.

In summarizing the authors state that a cupola slag fluxed with fluorspar is less basic and more viscous than a normal slag obtained by the use of a high percentage of limestone without such fluxing because the slag enriches itself with H_2SiO_3 and aluminum oxide. Besides it contains no fluorine. On the contrary this is completely volatilized in the formation of the aggregate slag, even before the final slag covers the main mass of reduced iron. Therefore, it is out of the question that fluorspar can be used as a desulphurizing agent in the cupola. Fluxing with fluorspar in the cupola operation, therefore, is useless and in fact harmful.

To Teach Beginners

Examples of a Number of Small Patterns, by Steghens. *La Revue de Fonderie Moderne*, Paris, March 10, 1927. The article is intended specially for apprentices in the pattern shop. The making of a number of patterns is described and illustrated. The examples chosen are: piston crossheads, pipe fittings, air receivers for pumps, machine-tool bases.

Making Semi-Steel

Semi-Steel, by J. E. Hurst, *Metal Industry* (London), March 11 and 18.

The author of this article points out that if the chemical composition of the mixture is suitable for the particular type of casting being made, no difficulty should be encountered in making semisteel casting. Steel additions act as a diluent and reduce the amount of silicon, manganese and phosphorus in the final product. The normal losses of silicon and manganese and the gain in sulphur in melting also must be considered, and the charge must be balanced so that the iron at the spout is of the proper composition. Mr. Hurst summarizes the conditions which influence the absorption of carbon as follows: The temperature attained in the cupola; the rapidity of melting and the length of time of contact of the steel, carbonaceous fuel and gases; length of time the molten metal lies in contact with the coke; surface area per unit weight of steel exposed to the carburizing and melting influences; character and amount of coke charged; blast pressure and quantity.

The author ascribes the improvement of physical properties of semisteel to the reduction of silicon and phosphorus. He also points out that the reduction of these elements increases shrinkage and lowers the fluidity of the metal. Therefore, provision must be made to have the iron sufficiently hot, and to assure that the heads, gates and runners of the mold be of the proper size and distribution.

Gives Malleable Data

Malleable Cast Iron, by M. Guédras, *La Revue de Fonderie Moderne*, March 25, 1927.

In the introduction the author states that the first attempt of softening cast iron was due to Réaumur in 1722, Since then new processes have been evolved and a large part of the progress made is due to discussions at international congresses. Reference is made to Samuel's work in 1804; the principle of his process still is followed in European practice for white heart malleable, in contradistinction to black heart malleable as made in America. With regard to chemical composition, distinction is made between the composition of the primary metal and that of the casting coming out of the annealing furnace. The carbon in the primary metal should be in the form of cementite.

Right proportions of manganese and especially silicon should be obtained and there should be no formation of graphite in the primary metal. The average carbon content in malleable iron made in the cupola is 3.2 per cent. It is of great importance to control the percentage of silicon. An excess causes the precipitation of graphite in the primary metal. White heart malleaole with 0.50 per cent silicon is the best. The percentage of manganese should be about 0.30 per cent. This percentage favors the separation of the carbon. The author agrees with Dr. Moldenke that sulphur should not exceed 0.05 per cent, but for practical purposes the usual percentage is 0.10 to 0.17 per cent. Manganese assists in elimination of sulphur. Phosphorus should be reduced to the minimum as it renders the metal fragile and causes the formation of hard spots.

Uses Waste Gases

Recuperation of Heat from the Gases of Annealing Furnaces. La Fonderie Moderne, Paris, February, 1927. A short article describing the installation of a Sulzer boiler heated by the gas coming from an annealing furnace at the Swiss Trading Co. at Neuhausen. A table shows the results obtained.

Describes Test Cupola

The Small Modern Cupola Used for Testing Cast Iron, by A. Defer, *La Revue de Fonderie Moderne*, March 25, 1927.

A special cupola of small dimensions has been devised to cast special mixtures of pig iron which are only needed in small quantities. This cupola can melt from 400 to 500 kilograms (880 to 1100 lbs.) per hour and tapping can commence from 1¼ to 1½ hours after lighting the cupola. The inside diameter of the shell is 600 millimeters (23.6 inches) the inside diameter of the lining is 350 millimeters (13.8 inches). The total height is 2.250 meters (8.2 feet) and the height of the zone of combustion is 1.80 meters (5.9 feet). The lining may be made with bricks of the usual description or with refractory sand. The top part of the cupola can be lifted from the lower part and can be swerved away from it to enable easy relining.

The Shakeout

DAN M. AVEY, Editor

PAT DWYER, Engineering Editor
FRANK G. STEINEBACH, Associate Editor

CHARLES VICKERS, Nonferrous Editor
EDWIN BREMER, Associate Editor

¶ Stock in Aviation Rises

CAPT. CHARLES A. LINDBERGH, in completing his famous flight from New York to Paris, brought fame and fortune to himself and rendered a great service to aviation. Not since the Wright brothers made the first flight in a heavier than air machine has the American nation shown such interest in air transportation. As the daring American youth landed his plane in France, the entire world paid homage to his courage and skill and to the pioneers who have made an uphill fight to perfect a machine capable of withstanding the rigorous test. Aviation surely will benefit from the interest which has been aroused in every city, town and village of the country.

AVIATION, as an industry, now is passing through a transition period of great magnitude. The harum-scarum days, which followed the dumping of thousands of government airplanes after the war, now are past. Planes, bought for almost a song and used by barnstormers to do stunt flying or to carry passengers gradually have worn out or have been wrecked. Many fly-by-night companies have gone out of business since funds were not available to replace the cheap planes retired from service. Today, commercial aviation companies generally have sound financial backing, employ experienced flyers and operate planes of the latest design. Safety has become the keynote as this phase of the industry has become stabilized and consequently the confidence of the public has increased.

THE manufacturer of airplanes gradually is adopting production methods developed in the automotive industry ten or more years ago. Automobile producers, in the early days of the industry, realized the advantage of limiting production to a small number of standardized models. On the other hand, airplane builders have been required to produce planes conforming to the ideas of the individual buyer. In practically every case a new order has involved new designs, new jigs, dies and other equipment as well as a partial rearrangement of the assembly floor. Where the production of one model of an automobile may be measured in thousands of cars, the airplane factory seldom has produced more than 50 planes of one model. However, several prominent airplane manufacturers now are swinging toward standardized production, each builder limiting the output of his plant to a few types of planes designed for specific work.

WITH aviation commanding the interest and confidence of the American public, with standardized methods of production growing and with experienced men at the helm, the industry bids fair to enjoy its greatest development within the next few years. The list of companies furnishing materials and parts used in the construction of Lindbergh's famous plane, the "Spirit of St. Louis" and reproduced elsewhere in this issue, tells an interesting story of the demands which will be made on industry as a whole as aviation grows. Foundrymen should take pride in the fact that all cast parts functioned perfectly.

¶ Opening the Family Album

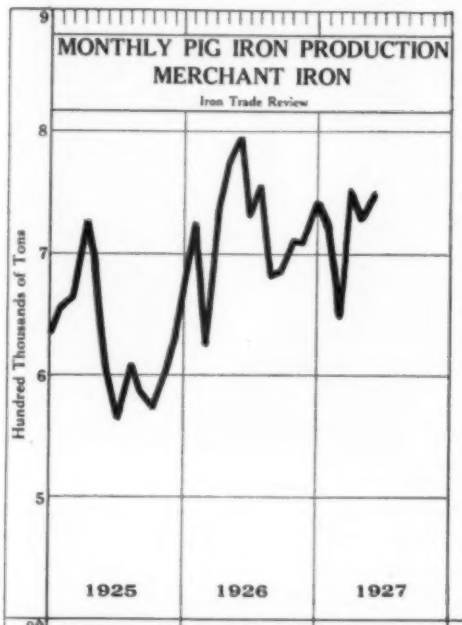
STARTING with this issue, THE FOUNDRY inaugurates a new feature, the *Family Photograph Album*, which will be continued from time to time as occasion warrants. On this page will be found those men who are making history and are recording the progress in the various ramifications of the foundry industry. The presentation of these portraits will fulfill a twofold purpose. Their appearance in the *Album* will present to these valued men the tribute of respectful appreciation that too often is not forthcoming until after they have departed. The commendation thus conveyed does not partake of the character of posthumous praise, but is a friendly gesture from fellow workers in this magnificent industry. The second purpose, which this feature doubtless will meet in increasing measure, is to acquaint the world wide circle of readers who receive THE FOUNDRY twice each month, with the personalities and appearance of outstanding characters whom they already know through their names, their work or their writings.

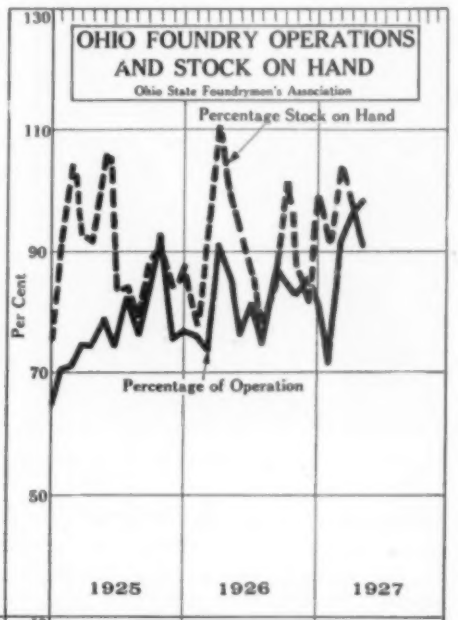
Trade Trends in Tabloid

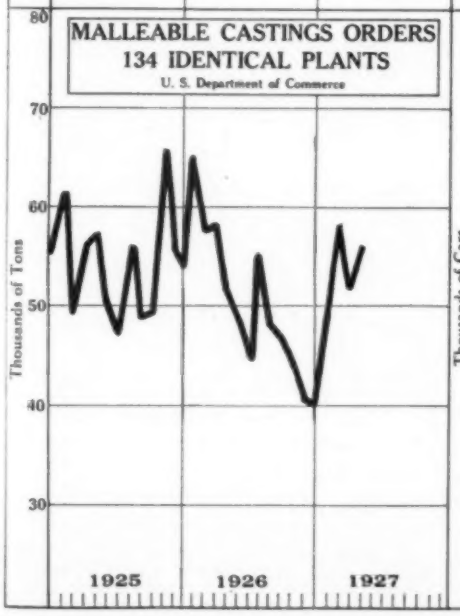
SLIGHT declines are noted in castings orders with the approach of the summer season. Automotive work is spotty, depending directly upon the sales totals of various types of cars. Demand for cast-iron pipe is slow, many projects being held in abeyance by municipalities. General jobbing gray iron castings demand is maintaining a fairly high level through the central west, but is retarded in the eastern section. Malleable foundry operations declined during April, according to the department of commerce, although orders have improved. Monthly pig iron production according to statistics compiled by *Iron Trade Review*, improved. On an estimated daily average basis, the output for April was 114, 146 tons per day compared with 109,388 tons in May, recording a loss of about 4 per cent. This is the first drop in rate of iron production since the first of the year. Average monthly prices for nonferrous metals during May, according to the *Daily Metal Trade* were as follows: Casting copper, 12.682c; electrolytic copper, 12.876c; Straits tin, 67.540; lead, 6.606c; antimony, 12-.885c; aluminum, 98 to 99 per cent, 25.440c and zinc average 6.079c, E. St. Louis, Ill. Brass foundry operations show some retardation, although inquiry and purchases of metals continue at a rate that evidences an expectation of improvement in the near future. Aluminum foundries making automotive work are slack.

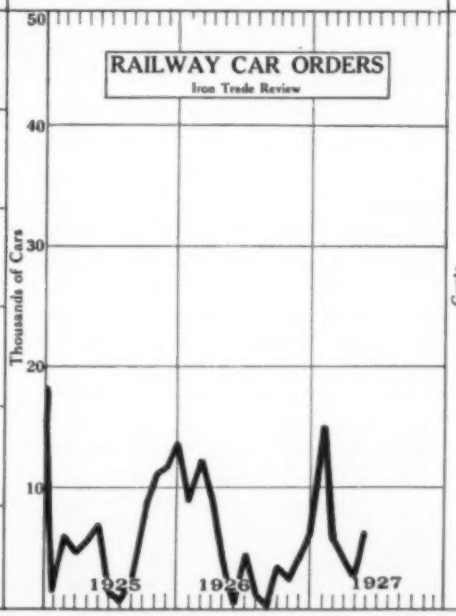
RAW MATERIAL PRICES
June 4, 1927

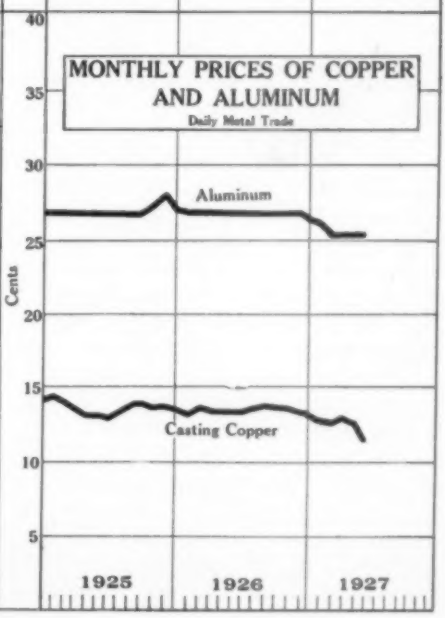
No. 2 foundry, Valley	$18.50
No. 2 southern, Birmingham	18.00
No. 2 foundry, Chicago	20.00
No. 2 foundry, Philadelphia	21.76 to 22.13
No. 2 foundry, Buffalo	17.75 to 18.00
Basic, Valley	18.00
Basic, Buffalo	17.25 to 17.75
Malleable, Chicago	20.00
Malleable, Buffalo	17.75 to 18.00
Coke	
Connellsville foundry coke	$3.75 to 4.50
Wise county foundry coke	6.00
Scrap	
Heavy melting steel, Valley	$15.00 to 15.50
Heavy melting steel, Pitts.	15.00 to 15.50
Heavy melting steel, Chicago	12.00 to 12.50
Stove plate, Chicago	12.50 to 13.00
No. 1 cast, New York	14.00 to 14.50
No. 1 cast, Chicago	15.00 to 15.50
No. 1 cast, Philadelphia	16.50 to 17.00
No. 1 cast, Pittsburgh	15.00 to 15.50
No. 1 cast, Birmingham	15.00 to 16.00
No. 1 cast, Buffalo	16.00 to 16.50
Car wheels, iron, Pittsburgh	15.00 to 15.50
Car wheels, iron, Chicago	13.50 to 14.00
Railroad malleable, Chicago	13.75 to 14.25
Agricultural, Mal., Chicago	13.00 to 13.75
Malleable, Buffalo	17.00 to 17.50
Railroad malleable, Pitts.	15.00 to 15.50
Nonferrous Metals	
	Cents per pound
Casting copper, refinery	12.50 to 12.62½
Electro copper, producers	12.75
Straits tin	68.25 to 68.50
Lead, New York	6.45
Antimony, New York	12.75
Nickel, electro	39.00
Aluminum, No. 12, prod'rs	24.50
Aluminum, No. 12, remelt	18.50 to 19.50
Zinc, E. St. Louis, Ill.	6.20











Comings and Goings of Foundrymen

J. J. BOLAND, superintendent, Detroit plant, Griffin Wheel Co., who was elected president of the Detroit Foundrymen's association at a recent meeting, was born in Chicago on Feb. 15, 1887. He was educated in the grammar and high schools and in St. Patrick's Commercial academy of that city. Mr. Boland spent his vacations in the mechanical department, locomotive division, Chicago &

J. J. BOLAND

Northwestern railroad, Chicago and after graduation he spent one year as timekeeper in the brass foundry, James B. Clow & Sons, Chicago. On Jan. 15, 1907 he entered the employ of the Griffin Wheel Co., Chicago, as a timekeeper in the brake shoe foundry of the Sacramento Square plant. Later Mr. Boland was transferred to the wheel foundry and worked in both the molding and cupola departments. In 1910 he was transferred to the accounting department and from 1912 to 1915 he had charge of the office of the Sacramento Square plant. During the war he was transferred back to the operating department as assistant superintendent and in February, 1920 was given charge of the Detroit plant with the title of superintendent. Mr. Boland joined the Detroit Foundrymen's association in 1924 and was elected vice president in 1926. His hobbies are hot-blast and skip-charged cupolas, mechanical molding, sand handling plants, and anything else used in connection with the foundry.

Edgar E. Mills, traffic manager, Fairbanks-Morse & Co., Indianapolis, recently was elected first vice president of the Indianapolis Traffic club.

F. Harold Daniels, president, Riley Stoker Corp., Worcester, Mass., sailed for Europe on May 26 on a combined pleasure and business trip.

Frank Cordes, who has been with the Wheeling Mold & Foundry Co., Wheeling, W. Va., for some time has been elected president of the Lewis Foundry & Machine Co., Pittsburgh and Groveton, Pa. He succeeds W. A. Herron, retired. J. R. Dunsford, also of the Wheeling company, has been appointed vice president and sales manager of the Lewis Foundry & Machine Co.

H. Zwicker, associated with the Grabler Mfg. Co., Cleveland, for 18 years and for the past 8 years in charge of the foundry, has resigned.

T. P. Gaylord, acting vice president, Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., has been elected president of the Pittsburgh chamber of commerce by the board of directors of that organization.

T. C. Pulman, managing director, Worthington-Simpson Ltd., British subsidiary of the Worthington Pump & Machinery Corp., New York, and J. B. Farwell, foreign manager of the company with headquarters at Paris, France, are in this country for a three week's conference with L. J. Belnap, president of the Worthington company.

Russell M. Scott who was recently elected vice president of the Detroit Foundrymen's association was born in Walkerville, Ont., Dec. 18, 1885. At an early age he moved to Cleveland where he attended the public schools and served his apprenticeship as a patternmaker at the Cleveland Punch & Shear Works. After two years spent in various shops, Mr. Scott became connected with the Packard Motor Car Co., Detroit in June, 1907. From that time until 1912 he worked at the bench as a patternmaker, being appointed assistant foreman in the latter year. In 1913 he was made general foreman, in 1920 assistant foundry superintendent and later foundry superintendent. In July, 1925 Mr. Scott was appointed foundry manager, having charge of the making of all patterns, brass, aluminum and gray iron castings. He comes from a family of foundrymen, his father having built the experimental patterns and supervised the making of castings for the first car made by the Packard company, and his two brothers also being connected with

RUSSELL M. SCOTT

the trade. Mr. Scott had been secretary of the Detroit Foundrymen's association for the past three years.

Establishes Practice

P. L. Livingston who for the past twenty years has been superintendent of foundries for various establishments, including the Goulds Pumps, Inc., Seneca Falls, N. Y.; C. & G. Cooper Co., Mt. Vernon, O.; and Clark Bros. Co., Olean, N. Y., has established a private consulting business in foundry engineering with offices at 298 Fall street, Seneca Falls, N. Y.

Will Hold Annual Outing

Members and guests of the Pittsburgh Foundrymen's association will hold their annual summer outing at Turner park, Perrysville, Pa., on June 20. An interesting program of events is in the course of preparation.

Amount of Coke Needed To Melt Hot Iron

Question: We are melting a mixture of 45 per cent cast iron, 30 per cent steel scrap and 25 per cent wrought iron scrap in a cupola lined to 42 inches. Iron for the first 1½ tons is hot enough, but after that it comes colder and commences sticking to the ladles. By the time we have 4 tons melted it will not run our castings and the ladles are all bunged up. Kindly give us the formula for charging a cupola of the size indicated. Also any other necessary information for melting the iron in a satisfactory manner. Air from a 35-inch fan is driven into the cupola through an 8½-inch diameter pipe.

Answer: Your blower and main blast pipe are approximately 50 per cent too small for the potential melting capacity of your cupola. However, while that feature slows down your melting speed, it should not affect the temperature of the iron unless the relative charges of coke and iron are entirely out of line. A 42-inch cupola should melt between 5 and 6 tons of iron per hour. The main air line should be at least 12 inches in diameter and the fan should deliver approximately 2500 cubic feet of air per minute.

From the fact that the iron continuously grows colder during the progress of the heat it is apparent that the bed is too low, also that succeeding charges of coke are not sufficient to renew it. In your case another factor also must be considered. Your peculiar mixture creates a great deal more slag than is found with ordinary gray iron and unless you are slagging the cupola freely, this material remains on the inside, where it freezes in the cold furnace and shuts off a great part of the air. If conditions warrant, the logical solution of your trouble is to install suitable blowing equipment so that the cupola may be operated to capacity. However, in the event that this is not feasible and you have to do the best you can with existing equipment, the following method of procedure will insure hot iron. Place a sufficent amount of coke on the bed so that after it has burned through and settled down it will extend about 30 inches above the tuyeres. Place an additional 6-inch thickness of fresh coke on the red bed and then charge 250 pounds of wrought iron 300 pounds of steel and 450 pounds of pig iron or any other gray iron you may have on hand. The remainder of the charge may be made up of alternate layers of coke and wrought iron-steel-gray iron in the proportion of 200 pounds of coke to 1000 pounds of metal. After a few trials this amount of coke may be cut down to some extent, but in your initial trials it is advisable to use plenty. To keep the furnace clean, throw three or four scoopfulls of limestone on every charge and open a slag hole at the back of the cupola and about 5 or 6 inches below the tuyere line so that the slag may flow readily out of the furnace as rapidly as it is formed. If this is not done the slag will build up, freeze and bung up the cupola.

Faked Foundry Facts

Tight Equipment

Foundry Association Directory

American Foundrymen's Association

President, S. W. UTLEY, Detroit Steel Casting Co., Detroit; secretary-treasurer, C. E. HOYT, 140 South Dearborn street, Chicago; technical secretary, R. E. KENNEDY, 909 W. California street, Urbana, Ill.

The Buffalo Foundrymen
Buffalo

President, J. MCARTHUR, Washington Iron Works; secretary, W. J. WARK, E. J. Woodison Co., 146 Chandler street. Meetings the third Wednesday of the month at 146 Chandler street.

Chicago Foundrymen's Club
Chicago

President, G. H. ROLINSON, American Brake Shoe & Foundry Co.; secretary, ALBERT N. WALLIN, S. Obermayer Co., 2563 W. Eighteenth street. Meetings second Saturday in each month at the City club, 315 Plymouth court.

Connecticut Foundrymen's Association

President, FRED W. STICKLE, Capitol Foundry Co., Hartford, Conn.; secretary, C. S. NEUMANN, Union Mfg. Co., New Britain, Conn. Meetings are on second Friday of each month in various parts of the state.

Detroit Foundrymen's Association
Detroit

President, J. J. BOLAND, Griffin Wheel Co., Detroit; secretary, ROBERT HOPE, Holley Carburetor Co., Detroit. Meetings third Thursday in each month at the Union League club, 35 Grand River avenue, Detroit.

East Bay Foundrymen's Association
Oakland, Calif.

Secretary, H. L. MARTIN, Marchant's Foundry Co., 4401 East Tenth street, Oakland, Calif.

Metropolitan Brass Founders' Association
New York

President, WILLIAM EMBER, Jefferson Brass Foundry, 62 Delevan street, Brooklyn, N. Y.; secretary WILLIAM E. PAULSON, Thomas Paulson & Son Inc., 97 Second avenue, Brooklyn, N. Y. Meeting second Wednesday in each month at the Building Trades club, 34 West Thirty-third street, New York.

Newark Foundrymen's Association
Newark, N. J.

President, J. L. CARTER, Barlow Foundry Inc., Newark; secretary, W. H. MANTZ, Atlas Foundry Co., Irvington, N. J. Meeting called by President.

New England Foundrymen's Association

President, HENRY S. CHAFEE, Builders Iron Foundry, Providence, R. I.; secretary, FRED F. STOCKWELL, 205 Broadway, Cambridgeport, Mass. Meetings second Wednesday of each month at the Exchange club, Boston. Outings usually are held in the summer months.

Ohio State Foundrymen's Association

President, WALTER L. SEELBACH, Walworth Run Foundry Co., 2488 West Twenty-seventh street, Cleveland; secretary-manager, ARTHUR J. TUSCANY, 5713 Euclid avenue, Cleveland.

Philadelphia Foundrymen's Association
Philadelphia

President, WALTER WOOD, R. D. Wood & Co., Philadelphia; secretary HOWARD EVANS, Union League club, Philadelphia. Meetings the second Wednesday of each month at the Manufacturers' club.

Southern Metal Trades Association
Atlanta, Ga.

President, GEORGE B. COCKER, Gastonia, N. C.; secretary, W. E. DUNN JR., Healy building, Atlanta, Ga.

Pittsburgh Foundrymen's Association
Pittsburgh

President, C. D. CAREY, American Steel Foundries, Pittsburgh; secretary-treasurer, WILLIAM J. BRANT, Wm. J. Brant, Bessemer building, Pittsburgh. Meeting on the third Monday of the month, except in July and August, at Fort Pitt hotel.

Quad-City Foundrymen's Association
Davenport, Iowa

President, J. H. DIEDRICH, Blackhawk Foundry & Machine Co., Davenport, Iowa; secretary-treasurer, A. D. ZIEBARTH, Davenport Foundry & Machine Co., Davenport, Iowa. Meetings the third Monday evening of each month, the meeting place being rotated between Moline, Rock Island and Davenport.

Tri-City Technical Council
Moline, Ill.

Chairman, H. BORNSTEIN, Deere & Co., Moline, Ill.; treasurer, MAX SKLOVSKY, Deere & Co., Moline, Ill. Combined meetings held only one or two times a year on call.

Tri-State Foundrymen's Association
Cincinnati

President, HAROLD P. RITTER, John A. Oberhelman Foundry Co., 3323 Colerain avenue; secretary, GEORGE W. PIEHL, Wessling Bros. Foundry Co., 1607 McLean avenue. Meetings the second Thursday of each month at the Cincinnati club, Eighth and Race streets.

Twin City Foundrymen's Association
Minneapolis-St. Paul

President, H. H. NOTT, Smith System Heating Co., Minneapolis; secretary-treasurer, C. E. LANGDON, 3849 Lyndale avenue, south, Minneapolis. Meetings monthly at the Athletic club.

British Foundrymen To Hold Annual Meet

The annual convention of the Institute of British Foundrymen will be held in Sheffield, England, from July 5 to 9. Arrangements have been made by the convention committee to entertain the visitors and an interesting program of papers has been provided for discussion. The American Exchange paper will be presented by J. T. MacKenzie, American Cast Iron Pipe Co., Birmingham, Ala. Plans also have been made for the visitation of a number of foundries in Sheffield. The schedule of events and papers to be read are presented in the accompanying box at the bottom of the page.

Newark Foundrymen Re-elect Officers

All officers of the Newark Foundrymen's association were re-elected at a recent meeting in Newark, N. J. J. L. Carter, Barlow Foundry Inc., Newark, is president; William Goldsmith, C. A. Goldsmith Co., Newark, vice president; J. A. Williamson, Isbell-Porter Co., Newark, treasurer; and W. H. Mantz, Atlas Foundry Co., Irvington, N. J., secretary. D. M. Houston, foundry engineer, International Nickel Co., New York, spoke on "The Use of Alloys in Cast Iron."

Appoints Representatives

J. B. McCarthy and W. P. Robinson have been appointed as Canadian representatives by the Electric Controller & Mfg. Co., Cleveland. Their offices are at 307 Redford building, Toronto, Ont., and 808 Drummond building, Montreal, Quebec. The Petroleum Electric Co., 217 East Archer street, Tulsa, Okla., has been appointed representative in Oklahoma and the Panhandle district of Texas.

Obituary

Edwin S. Jackman, aged 62 years, western sales manager at Chicago for the Firth-Sterling Steel Co., McKeesport, Pa., died May 30 at Santa Barbara, Calif. He was born in Pittsburgh but moved from that city 35 years ago to become a resident of Chicago. He went to California on a vacation about three months ago.

Frank N. Brayer, 72, for twenty years president and general manager of the Cooperative Foundry Co., Rochester, N. Y., died on June 2 at his home in Rochester.

Henry E. Russell, 88, retired New Britain, Conn., manufacturers, who rose from office boy to president of the Russell & Erwin Mfg. Co., died June 3 in that city. He underwent a serious operation in February. Mr. Russell was born in New York in 1838. For some years he represented the concern in London and Paris.

District Manager Dies

P. William Kromer, Buffalo district manager, Air Reduction Sales Co., died in that city May 21 following an illness of 5 weeks. Mr. Kromer was 47 years old and had been identified with the oxygen-acetylene industry for nearly 20 years. He had been with the Searchlight Co. and other producers of gases, later managed a welding shop in Binghampton, N. Y., and then became local manager of the Niagara Oxygen Co. For the past 11 years he had represented the Air Reduction Co., at Buffalo. He was a member of the American Welding society and numerous other organizations.

Program for British Convention

Tuesday, July 5.

6.00 p. m. General Council Meeting in the Cutlers' Hall Church Street, Sheffield.

8.00 p. m. A cordial invitation is extended by the Master and Mistress Cutler (Mr. and Mrs. David Flather), to all Members, Delegates, and Ladies to a reception at the Cutlers' Hall. Refreshments. Dancing, 9 to 11.

Wednesday, July 6.

9.30 a. m. Conference commences at the Applied Science Department of the University of Sheffield, St. George's Square.
Welcome by SIR HENRY HADOW, vice chancellor, Sheffield university; Alderman J. G. GRAVES, lord mayor; DAVID FLATHER, master cutler; J. H. CHAPMAN, Esq., president, Sheffield chamber of commerce.

1.00 p. m. Lunch at the University, Western bank.

2.00 p. m. Motor coach trip to Baslow to visit Chatsworth House. Tea will be provided at the Grand Hotel, Baslow.

2.15 p. m. Visits to the works of Edgar Allen & Co., Ltd.; Cammell, Laird & Co., Ltd.; Newton, Chambers & Co., Ltd., and Vickers, Ltd.

7.15 p. m. Dinner at the Royal Victoria Hotel, for members, delegates, and ladies. Dancing, 10.30 to 12 p. m., providing sufficient applications are received.

Thursday, July 7.

9.30 a. m. Conference resumes at the University, St. George's Square.

1.00 p. m. Adjourn for lunch at the University, Western bank, 1.15 p. m.

2.30 p. m. Conference continues.

4.30 p. m. Civic reception at the Town hall by the lord mayor and lady mayoress. Afternoon Tea. (Members, delegates and ladies).

8.30 p. m. All members, delegates and ladies are invited to the Hippodrome by the convention committee.

Friday, July 8.

9.30 a. m. Visits to the works of Brown-Firth Research Laboratories; Darwins, Ltd.; Davy Bros., Ltd.; Samuel Osborn & Co., Ltd.

1.00 p. m. Lunch at the Grand hotel, Sheffield.

2.30 p. m. Motor Coaches to Derbyshire Dales.

Papers At The Conference

American Exchange Paper. The Properties of Coke Affecting the Cupola Melting of Steel, by J. T. MacKenzie, American Cast Iron Pipe Company, Birmingham, Alabama; *Belgian Exchange Paper.* Some Methods of Making Steel Castings, by Georges Fosseprez; *French Exchange Paper.* The Making of Steam Engine Cylinders, by M. Audo, chief of foundries, Paris-Orleans Railway Co.; The Influence of Chromium and Nickel on High Quality and Heat Treated Cast Irons, by Prof. Piwowarsky, Technical High school, Aachen, Germany; The Importance of Air Control in Efficient Cupola Practice, by P. H. Wilson, general foundry manager, Stanton Ironworks Co. Ltd.; The Manufacture of a Large Steel Casting, by F. A. Melmoth and T. Brown, Thos. Firth & Sons, Ltd.; Strains in Non-Ferrous Casting, by C. H. Desch, professor of metallurgy, University of Sheffield; The Strength of Cast Iron, by J. E. Fletcher, consultant, British Cast Iron Research association; The Effect of Manganese and Manganese Sulphide in Whiteheart Malleable, by E. R. Taylor; *High Test Cast Iron, by F. M. Robbins, Chattanooga, Tenn.

*Owing to additional research work, this paper may not be read until next year.

Introduces Vibrator

The Tessmer Machine & Tool Co., Rivard and Mullett streets, Detroit, recently has designed a vibrator with a special self-starting feature. The device is provided with a nonrusting valve which is controlled automatically by the operation of the knee valve.

A SPECIAL STARTING FEATURE IS USED

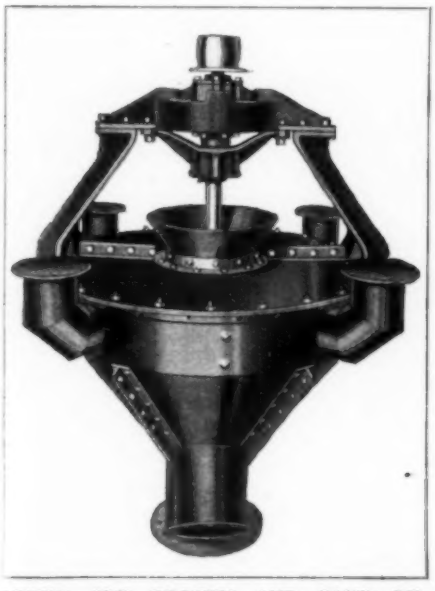
This valve is at rest at all times and it is claimed will last indefinitely as there are no delicate parts to wear or break. The bodies of the vibrators are made of semisteel with hardened and ground steel sleeves pressed into place and a hardened and ground steel piston. The starter places and holds the piston in a starting position until the air is admitted into the vibrator and then releases the piston for service.

Removes Dust from Sand

A separator designed to remove dust and fines from foundry sand, break up the lumps and screen the sand in one operation, recently has been introduced by the National Engineering Co., 549 West Washington boulevard, Chicago.

After the sand is fed into a hopper on top of the machine, it falls on a fan and is hurled outward by centrifugal force against the inner face of a breaking ring, thus breaking up the lumps. From the breaker ring, the air circulation screens the sand through a conical screen, the screened sand falling through the spout at the bottom of the machine. The tailings are removed through a refuse spout on the front of the machine. The action of the fan separates the dust and fines from the screened sand. These fines are removed through the four spouts at the top of the machine and can be piped out of the building or to a dust collector.

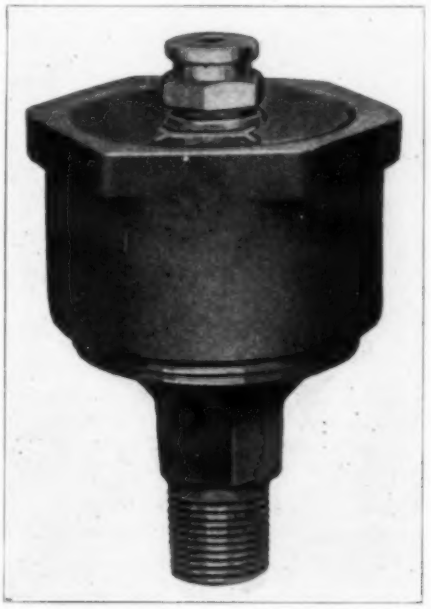
This machine is of rigid construction. The crossbeam and supports are steel castings. Roller bearings are used for both upper and lower bearings on the fan shaft. The screen can be replaced easily and either belt or direct motor drive can be used.



LUMPS ARE BROKEN AND SAND REMOVED IN ONE OPERATION

Uses Forced Lubrication

The Link-Belt Co., 910 South Michigan avenue, Chicago, has developed a new malleable iron compression grease cup which may be equipped with fittings for various types of



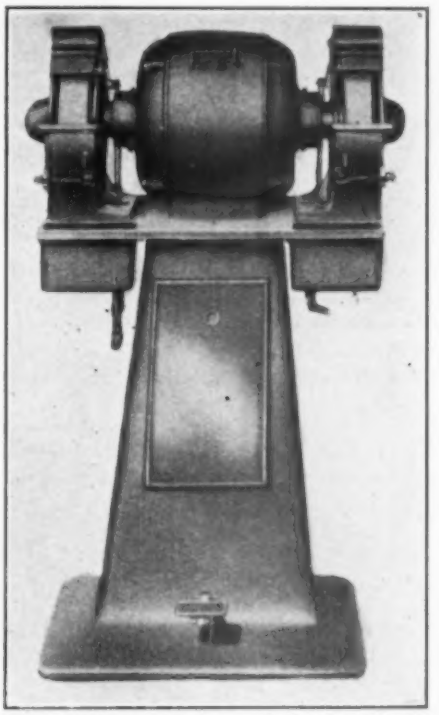
CUPS ARE MADE OF MALLEABLE IRON

forced lubrication. The head of the cup is six sided to permit the use of any type of wrench. With this type of cup it is claimed that the filling may be accomplished without the waste of grease and without inconvenience. The cup holds a good reserve for use of the compressive feature. An occasional turning of the cup with a wrench or by hand is all that is necessary until time to have a general refilling of all cups.

E. B. Brown, formerly connected with the Whiting Corp. and the Universal Portland Cement Co., Chicago, in a sales capacity, has become associated with Page & Ludwig, Chicago, foundry equipment agents, in a similar capacity.

Uses Spark Shield

The Black & Decker Mfg. Co., Towson, Md., recently has made a number of changes in the design of one of its line of grinding machines. This grinder which is shown in the accompanying illustration accommodates a 12-inch wheel and is equipped with



THE GRINDER USES A 12-INCH WHEEL

adjustable guards. The machine is provided with tool rests mounted on the lower lip of the guard and a special spark shield located on the upper lip of the guard. The special spark shield is arranged so that it hugs the wheel automatically, being controlled by the adjusting of the guard as the wheel diameter decreases with wear. The machine is controlled with a foot pedal. The machine is driven by a 3 horsepower electric motor and the speed of the wheel is 1800 revolutions per minute.

Wisconsin Group Meets

The fourth regular monthly meeting of the Wisconsin Gray Iron Research group was held at the Republican house, Milwaukee, on June 1. No meetings will be held during July and August. Regular meetings will be resumed on Sept. 7.

Buffalo Foundrymen Meet

At the regular meeting of the Buffalo Foundrymen which was held on May 11, George Pickop, Malleable Iron Fittings Co., Branford, Conn., spoke on vibrators and shakeout devices.

What the Foundries Are Doing

Activities of the Gray Iron, Malleable, Steel and Brass Shops

Mueller Brass Co., Port Huron, Mich., plans to build a 1 and 2-story addition.

Clyde Castings Co., Clyde, O., Fred Whitcomb, president, will build a factory 40 x 200 feet.

Southwestern Brass Works, Fort Worth, Tex., has been incorporated by A. B. Garrett and J. P. Mennell.

Bohn Aluminum & Bronze Corp., 2512 East Grand boulevard, Detroit, will build a 1-story foundry addition.

Doehler Die Casting Co., Batavia, N. Y., plans to expand and to increase in production of metal products aside from castings.

Mid-City Foundry Corp., Chicago, has removed its office and foundry to a new location at 945 West 49th place.

Miller Molding Machine Co., makers of glass molding equipment, is planning to construct a new foundry at Canton, O.

Keubler Foundries Inc., Easton, Pa., William J. Kuebler, president, has decided to go out of business and liquidate.

Hatfield Foundry Co., Hatfield, Pa., has been incorporated with $15,000 capital to carry on a general foundry business by William B. Hedrick, Hatfield, Pa.

Worthington Pump & Machinery Corp., Holyoke, Mass., has awarded the general contract for an addition to its machine shop, to Casper Ranger Construction Co.

Detroit Gray Iron Foundry Co., Detroit, will erect an addition to its factory in the immediate future. Plans are being prepared now, details of which have not been announced.

Riverside Iron Works, Calgary, Alta., has started work on an addition to its plant at 803 Twenty-fourth avenue to cost $20,000. It is the intention to build a second addition later.

Kilgore Foundry Co., Newcomerstown, O., recently has been incorporated with 1000 shares no par value by Ross J. Thomas, J. D. Kilgore, Merle W. Coulter, D. A. Swisher and F. R. Graham.

Moloch Foundry & Machine Co., Kaukauna, Wis., will proceed with construction of a new foundry 75 x 150 feet, to cost $50,000 as quickly as insurance adjustments on the recent fire loss are completed.

Portage Bronze Electric Co., Portage, Pa., has been incorporated with $50,000 capital to manufacture brass pumps, electric machinery and other devices by Francis R. Skelly, 160 Hammer avenue.

Gould Castings Corp., 5256 Vernon street, St. Louis, is working on plans for its new plant in Kansas City, Mo., to include a foundry, pattern shop, machine shop and other structures.

The plant of the Valley Mould & Iron Co., Sharpsville, Pa., has closed down but likely will resume early in June. The company is going ahead with construction of its plant at Hubbard, O.

Adams & Westlake, F. W. Holt, manager, 319 West Ontario street, Chicago, has awarded the general contract for a 2-story factory at Elkhart, Ind., to Ralph Sollitt & Sons Construction Co., Sample street, South Bend, Ind.

Wisconsin Iron & Metal Co., 129 Washington street, Oshkosh, Wis., is preparing for the construction of a new plant, 100 x 150 and 60 x 120 feet, at 164 Marion street, to supplant the group of buildings recently destroyed by fire. The cost will be about $50,000. Morris Block is president and manager.

Lake Shore Brass Co., Holland, Mich., has been organized to manufacture bronze, aluminum and brass castings. Officers of the firms are A. W. Wiliden, president; W. E. Dunn, vice president and Ernest Sulkers, secretary-treasurer.

Adrian Casting Co., Adrian, Mich., Anchor Concrete Machinery Co., Adrian, Ideal Concrete Machinery Co., Cincinnati, T. W. Noble Co., Chicago and the Universal Tamping Machinery Co., Peoria, Ill., have been merged to form the Consolidated Concrete Machinery Corp., with general offices at Adrian, Mich.

Control Machines, Ltd., Calgary, Alta., has been incorporated to carry on the business of iron founder, mechanical engineer and manufacturer of machinery, with $100,000 capital stock by Percy L. Stanford, Everett L. Chamber, Lewis C. R. Souter, and others.

Several Chicago aldermen are seeking to have reopened the Chicago Municipal Foundry and shops at Thirty-first street and Sacramento avenue which were closed 5 years ago because they failed to yield a profit on operations. Supporting the proposal to reopen the shops and foundry, John F. Schilt, president, metal trades council, declared that $250,000 had been invested in the foundry and shops, and that they should be utilized in employing molders and other mechanics now out of work.

New Trade Publications

DUST COLLECTORS—Northern Blower Co., Cleveland, has issued a circular covering the subject of dust in industrial plants, its collection as a matter of removal and as salvage, with suggestions as to equipment to give best results.

LABORATORY WORK—Cosma Laboratories Co., Cleveland, tells in a leaflet how it is equipped to render laboratory service to those requiring such assistance in their manufacturing processes, but not enough to maintain a laboratory.

ELECTRIC WELDING—Electric Arc Cutting & Welding Co., Newark, N. J., has issued two bulletins, one describing its generator for alternating and direct current and its portable welding device.

ARC WELDING ACCESSORIES—Importance of accessories used in arc welding is stressed in a bulletin by the General Electric Co., Schenectady, N. Y. Shields, helmets, electrode holders, brushes, electrodes, cable and other devices are illustrated and described.

PYROMETER—Pyrometer Instrument Co., New York, has issued a leaflet describing its radiation pyrometer, with description of its construction and use to determine temperatures from a distance.

THERMAL MEASUREMENT—A dilatometer for laboratory research is described in a bulletin by the Stanley P. Rockwell Co., Hartford, Conn. This is a more convenient form of measuring device than that used for regular measurement in industry and is designed with laboratory use particularly in view.

CONVEYORS—Mathews Conveyor Co., Ellwood City, Pa., has issued a catalog of its conveying devices. It is fully illustrated by halftones of typical installations in a wide range of uses, some of them not usually in mind. Details of construction and blueprints are presented to give a full understanding of the conveyors.

SANDBLAST MILLS—The W. W. Sly Mfg. Co., Cleveland, has issued an 8-page folder describing its tilted type sandblast mills. These mills are made 3 sizes and the principal features and specifications of each are presented.

BABBITT METAL—Hoyt Metals Co., St. Louis, has issued a booklet on babbitt metal data. Information selection of the alloy, considerations in designing bearings and preparations for casting are given.

ELEVATORS—Warner Elevator Mfg. Co., Cincinnati, has issued a catalog containing specifications for passenger and freight elevators for architects and engineers.

LIMIT STOPS AND COMPENSATORS—Electric Controller & Mfg. Co., Cleveland, has issued two bulletins dealing with limit stops for alternating and direct current motors on cranes or other power driven machines which must be stopped automatically, and compensators for squirrel-cage and synchronous motors.

ACETYLENE GENERATORS—Air Reduction Sales Co., New York, has issued a section of its catalog on generators for acetylene gas production, standard and portable. The various types are illustrated and data given.

STEEL LIFT TRUCKS—A list of parts for its steel lift trucks has been issued by the Stuebing Cowan Co., Cincinnati. The various parts are listed, illustrated and described and a list of accessories and specialties also is given, with instructions for ordering.

ELECTRIC FURNACES—W. S. Rockwell Co., New York, has issued a bulletin covering its revolving rotary type electric furnaces for use in heat treating metal parts. It is illustrated and its mode of operation is described fully.

SPACE HEATERS—Cutler-Hammer Mfg. Co., Milwaukee, has published a booklet describing various uses of its electric space heaters in industrial establishments.

CARBON DIOXIDE METERS—Leeds & Northrup Co., Philadelphia, manufacturer of electrical measuring instruments, has issued a bulletin covering its device for measuring carbon dioxide in gases passing to the stack from furnaces. It is illustrated to show installation and other details of the device.